Cottage Country

An environmental manual for the cottager

84- 4387 /

What Can the Cottager Do?

How do I purify my water for drinking? What can I do about lake water quality? Are sport fish safe to eat? Can I use pesticides? How shall I dispose of my garbage? How much of a pollution problem is boating?

These, and countless other questions, are continually being asked by the cottager. We, at the Ministry of the Environment, therefore, recognized the need to provide a readily available reference source to help the cottager protect his environment.

Which is why - in co-operation with many technical experts, and the Federation of Ontario Cottagers Associations - we have updated our easy-to-read and factual manual specifically examining cottage country environmental problems.

In this second edition, you may notice that we have expanded the section on acid rain. We have also provided a new list noting the phosphate content of household detergents. In addition, major changes have been made to the sections on "Purifying Water for Drinking", and "Toilets and Unsewered Waste Disposal Systems".

We have tried to answer as many of your questions as possible. Where appropriate, we've also detailed sources of further information,including available literature and contact points at the various government agencies. Feel free to contact them. There will probably be an office close to you.

Meanwhile, good reading, and good cottaging.

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CHAPTER I
WATER QUALITY

Countless influences affect your lake's water quality. Some you can do something about. Some you can't. In either case, you should know the facts.

Let's look at the major influences.

Good Bacteria, Bad Bacteria

For the sake of simplicity, water micro-organisms can be divided into two groups:

1. bacteria that thrive in a lake environment and make up the natural bacterial flora; and,
2. disease-causing micro-organisms, called **pathogens**, that can infect human tissues.

The **pathogens** are generally introduced to an aquatic environment by raw or inadequately treated sewage, although a few are found naturally in the soil. Other sources of pathogens include cats and dogs, chipmunks and even loons.

The presence of these bacteria does not change the appearance of water, but they pose an immediate health hazard if the water is used for drinking or swimming. (Hence the obvious need to disinfect water supply from the lake.)

This hazard does not necessarily mean that you will contract such serious waterborne infections as typhoid fever, polio or hepatitis, but you may catch the less serious gastroenteritis (stomach flu), dysentery or diarrhea.

Included in this minor category are eye, ear and throat infections that swimmers encounter every year, and the more insidious but seldom diagnosed, subclinical infections usually associated with several waterborne viruses. These viral infections leave a person not feeling well enough to enjoy holidaying, although not bedridden.

This type of microbial pollution can be remedied by preventing wastes from reaching the lake. Since disease-causing bacteria usually do not thrive in an aquatic environment, water quality should return to satisfactory conditions within approximately one year after remedial measures are implemented.

Tell-tale weeds, symptom of eutrophication.

The Effect of Bacteria on Oxygen

The remaining bacteria, instruments of normal and necessary decay, live and thrive within a lake environment. Any organic matter in the water will be used as food by these organisms and cause a subsequent increase in their number.

These lake bacteria play an important role in breaking down natural organic matter, as well as sewage, kitchen wastes, oil and gasoline. Unfortunately, degradation of organic waste by micro-organisms uses large amounts of dissolved oxygen. If the organic content of the lake gets high enough, the action of these bacteria will deplete the dissolved oxygen supply in the bottom waters and threaten the survival of many deep-water fish.

What's a Coliform?

Bacteriological tests on water are made primarily to determine the presence of organisms of the coliform group. These exist in the intestines of warm-blooded animals (including humans), and are used as an index of the presence of fecal material.

Their presence in any significant amount in water samples is an indicator of pollution, and the presence of other harmful pathogenic bacteria must be assumed until proved otherwise.

Conversely, the absence of coliforms is considered sufficient evidence of the absence of pollution, and indicates the water is suitable for drinking, bathing, etc. **at the time of sampling. However, no surface water is recommended for drinking even though coliforms are absent.**

Rainfall Runoff — A Hidden Polluter

The "Rainfall Effect" relates to a phenomenon in which heavy precipitation flushes the land around a lake and carries contaminants (including sewage organisms and natural soil bacteria) into the water.

In this way, total coliforms, fecal coliforms and fecal streptococci, as well as other bacteria and viruses from human waste disposal systems and animal droppings, can contaminate a lake. This phenomenon is particularly evident in Precambrian areas where there is inadequate soil cover, and in fractured limestone areas where fissures in the rocks provide access to the lake.

Melting snow provides the same transportation function for bacteria, especially in an agricultural area where manure spreading is carried out in winter on top of snow.

Scientific research suggests that (at sampling points 15 to 30 metres from shore) any contamination gen-

erally appears within 12 to 48 hours after a heavy rainfall.

To combat this hidden polluter, natural vegetation between the cottage and the lake should be preserved to absorb the runoff and seepage. Vegetation slows down runoff and acts as a natural filter of storm water from roads, parking lots, patios and cottage roofs, etc.

In places where the natural vegetation has been removed, cottagers should plant new trees and shrubs. Mature trees and shrubs on a cottage lot dissipate the energy of rainfall and reduce soil erosion.

The area over septic tank tile beds should be grassed and left open to the sun and wind so that maximum evaporation can take place.

The natural filtering by trees, grass and shrubs around a cottage provides significant protection for lake waters. During summer, the vegetation also uses nutrients that reach the groundwater from septic tank systems.

However, note that when you fertilize your lawn, you also fertilize the algae and weeds in the lake.

EUTROPHICATION (OR EXCESSIVE FERTILIZATION)

Why We Need Weeds, Why We Don't

In recent years, most cottagers have become well aware of the problems associated with nutrient enrichment (eutrophication) of recreational lakes.

The symptoms are well known: algae, excessive weeds, etc.

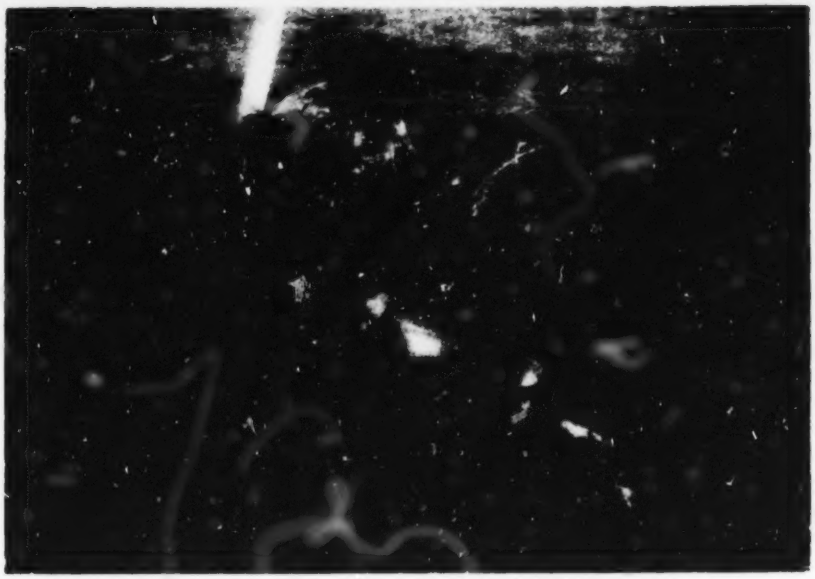
But it's important to realize that small to moderate amounts of aquatic plants and algae are necessary to maintain a balanced aquatic environment.

They provide food and a suitable environment for the growth of aquatic invertebrate organisms, which serve as food for fish. Moreover, shade from large aquatic plants also provides protection for young game and forage fish, and helps keep the lower water cool, which is essential to certain fish.

In addition, numerous aquatic plants are used for food and/or protection by many species of waterfowl.

Too much growth, however, creates an imbalance in the natural plant and animal community. The end result is that there may be too much cover for fish, causing them to be stunted. Also, such desirable forms of life as sport fish can be eliminated, and unsightly algal scums can form, causing interference to recreation.

The lake will not be "dead" but rather abound with life, which is not considered aesthetically pleasing.



Perhaps you've seen ponds and lakes covered with dense mats of decomposing surface-type algae. You'll know then how they can ruin such recreational activities as fishing, swimming or boating. In addition, decaying masses of vegetation may cause water to become less palatable to humans or to domestic livestock. Also, winter-kills of fish may result from oxygen depletion in the water caused by plant decomposition under the ice

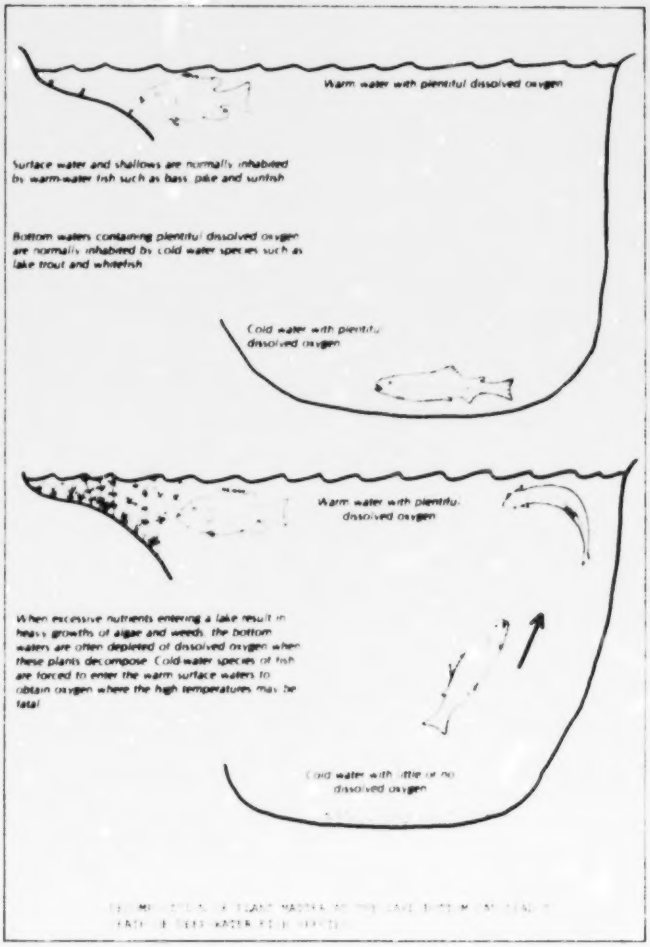
Water Quality Changes With Depth

Changes in water quality with depth are a very important characteristic of any lake. Water temperatures are uniform throughout a lake in the early spring and winds generally keep the entire volume well mixed.

Shallow lakes may remain well mixed all summer so that water quality will be the same throughout.

In deep lakes, on the other hand, the surface waters warm up during late spring and early summer, and float on the cooler, more dense water below.

The difference in density offers a resistance to mixing by wind action and many lakes do not become fully mixed again until the surface waters cool down in the fall. The bottom water receives no oxygen from the atmosphere during this unmixed period, and the dissolved oxygen


Warm water with plentiful dissolved oxygen
Surface water and shallows are normally inhabited by warm-water fish such as bass, pike and sunfish
Bottom waters containing plentiful dissolved oxygen are normally inhabited by cold water species such as lake trout and whitefish
Cold water with plentiful dissolved oxygen
Warm water with plentiful dissolved oxygen
When excessive nutrients entering a lake result in heavy growths of algae and weeds, the bottom waters are often depleted of dissolved oxygen when these plants decompose. Cold-water species of fish are forced to enter the warm surface waters to obtain oxygen where the high temperatures may be fatal
Cold water with little or no dissolved oxygen

Decomposition of plant matter at the lake bottom can lead to death of deep-water species.

supply may be all used up by bacteria as they decompose organic matter.

Cold water fish, such as trout, will have to move to the warm surface waters to get oxygen, and because of the high water temperatures they will not thrive, so that the species will probably die out (see above Figure).

Algae Aggravates

Low oxygen conditions in the bottom waters are not necessarily an indication of pollution. But excessive aquatic plant and algal growth and subsequent decomposition (particularly at the end of the season) will aggravate the condition. In some cases this results in zero oxygen levels in lakes that had previously held some oxygen in the bottom waters all summer.

Although plant nutrients normally accumulate in the bottom of lakes, they do so to a much greater extent if there is no oxygen present.

When the lake mixes in the fall, these nutrients become available for algae in the surface waters and dense algae growths can result.

Consequently, lakes that have no oxygen in the bottom water during the summer are more prone to having algal problems, and are more vulnerable to nutrient inputs.

How to Limit Nutrients

Like humans, aquatic plants and algae require a balanced "diet" for growth. Other special requirements, including light and temperature, are specific for certain algae and plants. Chemical elements such as nitrogen, phosphorus, carbon, and several others, are also required, and must be in a form available for uptake by plants and algae.

Algal growth can be limited by a scarcity of any single "critical" nutrient. Nitrogen and phosphorus are usually considered "critical" nutrients because they are usually in scarce supply in natural waters, particularly in Precambrian Shield lakes.

Human and livestock wastes can be a very significant source of these and other nutrients for lakes.

It is extremely important, therefore, that cottage waste disposal systems function so that seepage of nutrients to the lake does not occur. Indeed, excessive growths of algae and aquatic plants in a lake may well indicate a seepage problem.

The Phosphorus in Your Detergents

Scientists have recognized that phosphorus is the key nutrient in stimulating algal growth in lakes and streams.

In past years, approximately 50 per cent of the phosphorus contributed by municipal sewage was added by detergents. Federal regulations reduced the phosphate content (as P_2O_5) in laundry detergents from approximately 50 per cent to 20 per cent on August 1, 1970, and to 5 per cent on January 1, 1973.

But automatic dishwashing compounds were not subject to the government regulations, and are consequently high in phosphorus. Surprisingly, many automatic dishwashers are present in resort areas (a recent questionnaire indicated that about 30 per cent of the cottages in the Muskoka lakes have automatic dishwashers). Cottagers, therefore, may unknowingly be contributing significant amounts of phosphorus to their lakes.

Fortunately, in much of Ontario's vacation land, the source of domestic water is soft enough to allow the exclusive use of liquid dishwashing compounds, soap and soap-flakes, which are generally relatively low in phosphorus.

Facts About Laundry Detergents

The Environmental Protection Service of Environment Canada regularly samples a large number of domestic, commercial and industrial laundry detergents, to ensure that its phosphorus regulations are met.

The following lists are extracted from surveys conducted during 1980-81 in Ontario.

It must be noted that since manufacturers can, and do, change their product lines from time to time, only those products that were available at the time of the testing are reported.

For further information on the Canada Water Act, Phosphorus Concentration Control Regulations, or the activities of the Detergent Phosphorus Concentration Control program, please contact:

Environmental Protection Service
Water Pollution Control Directorate
Environment Canada
Ottawa, Ontario
K1A 1C8
Tel. (819) 997-1612

Detergents

a) Samples of the following "Laundry Detergent" for domestic, commercial or industrial use were found to contain less than 1% P_2O_5 or "No phosphate" at the time of testing in 1981;

AMWAY L.O.C. (Regular)
AMWAY L.O.C. (High Suds)
AMWAY SA-8 (Liquid)
ARTIC SYNTEX M
ARLAC
AYGAL GENERIC
BASIC-H (Shaklee)
BASIC-I (Shaklee)
BASIC-L (Shaklee)
BETTER BUY
BORAX
CANFOOD GENERIC
CO-OP
CLARIX
CLASSIC LAUNDRY SOUR
CLIMAX
CROWN LOSUDZ
DB-65
DILIGENT
DOXITE
DYNAMO
EATONS LOSUDZ
ENVIRO LAUNDRY DETERGENT
ENVIRO LAUNDRY DETERGENT PLUS
FEATURE
FORMULA D-29
FORMULA D-36
G.P. 115 M
HARMONIE
HI POWER (Miracle Food Mart)
HI POWER (Steinberg)
INDAL
IVORY SNOW
JET
LAUNDRI BUILDER
LAUNDRI CLOUT
LAUNDRI FLUFF
LAUNDRI LIQUID SOFT
LAUNDRI PREP
LAUNDRI RUST REMOVER
LAUNDRI SOFT POWDER
LAUNDRI SOUR
LAUNDRY BAR "R"
LAUNDRY DETERGENT "3D"
LAUNDRY SPOTTER
LOBLAW
MARCHAN GENERIC
MOYAL BROTHERS GENERIC
MOHAWK SOAP
NEPTUNE
NUTROX
P.D. 4492-0
POLYSOL
POW
PR-76
REFRANE
RINTEX
SAIL (Box)
SAIL A&P (Poly)
SCOTCH BUY
SEARS HEAVY DUTY (white powder)
SEARS LAUNDRY DETERGENT (blue liquid)
SILVERWOODS LOSUDZ
SPARKETTE
SUNFRESH NO-NAME
SUPER FORMULA HEAVY DUTY (Powder)
SUPER FORMULA HEAVY DUTY (Liquid)
SUPER LAUNDRY LIQUID SOFT/SOUR
STERLING BYESOL LIQUID
STERLING XE
STERLING PLUS LIQUID
SWIFTS SOLAR REGULAR
SWIFTS SOLAR F-342
SWIFTS SOLAR H.D. WHITE
SWIFTS SOLAR LLC-361
SWIFTS SOLAR 40
SWIFTS SOLAR 80
SWIFTS SOLARSOLVE DETERGENT
SWIFTS SPECIAL SOAP
SWIFTS WOOL SOAP POWDER
SWIFTS XP70
TRI-STAR AQUA SOFT
VANCOUVER ONLY
VOUCH
WIPEX M
WISK
WHITE LABEL
WOOLITE (powder)
WOOLITE (liquid)
WYN F102
WYN F901
ZERO (Liquid)

b) Phosphate level of "Laundry Detergents" within the "5% P_2O_5 limit" at the time of testing in 1981;

ABC
AERO
ALL
AMWAY SA8 (powder)
AMWAY TRI-ZYME
ARBOR "EXTRA"
ARCTIC POWER XE
ARCTIC SYNTEX H.D.
BIO-AID
BILTRITE
BLUE CYCLONE
BLUE DETERGENT 20-20
BOLD
BOOSTER BLUE
BOR-A-ZYME
BRAWN
BREEZE
BYESOL BLUE H.D.
CHEER
CLAX
CONTROL
CREST
CREST-LO
DIAPER PURE
DOMINION BLUE
DREFT
ENVIRO LAUNDRY BREAK
FAB
FOOD CITY
HANDLE CASE (Neopane)
H.D. BYESOL BLUE
HI POWER (Lo Suds)
I.G.A. BLUE
INDETTE
KENTAX
KENSUDS
KER-CELL
KLOR-X-TRA
LAUNDREX
LAUNDRI BREAK
LAUNDRI CONDITIONER
LAUNDRI PERMA BRITE
LAUNDRI SHEEN
LAUNDRI SL-86
LAUNDRI SPECIAL
LAUNDRI SUDS
LAUNDRY FORMULA B.L.
LAUNDRY FORMULA H.V.
MCDONAND'S
METRAX
NOBLA
ONE SHOT INSTITUTIONAL (B. Chambers)
ONE SHOT INSTITUTIONAL (G.H. Wood)
OXYDOL
PENNEX
PENNICO PLUS
PENSAL XX
PERMA-PRESS
POLY D
PUNCH
QUIX
SKORTEX
SUPER LAUNDRY LIQUID BREAK
SUPER LAUNDRY LIQUID DETERGENT
SURF
SUNLIGHT
SWIFTS SUPER SOLAR H.D. WHITE
TIDE
TRI-STAR L-2000
VAL-U
VERSAL
WESTERN FAMILY
WHITE CYCLONE
WHIRLAWAY BREAK
WHIRLAWAY ONE SHOT
WHIRLAWAY HOT SHOT
WYN F101
X.L.F. NO. 5
ZERO (powder)

How to Measure Enrichment in Your Lake

Large amounts of suspended algae, which materialize from excessive inputs of nutrients, result in turbid water of poor clarity or transparency.

On the other hand, lakes with only small inputs of nutrients and correspondingly low nutrient concentrations (characteristically large and deep lakes) often support small amounts of suspended algae, and consequently are clear-water lakes.

An indication of the degree of enrichment of lakes can therefore be gained by:

1. measuring the density of suspended algae (as indicated by the chlorophyll **a** concentration — the green pigment in most plants and algae); and
2. examining water clarity with a Secchi disc.

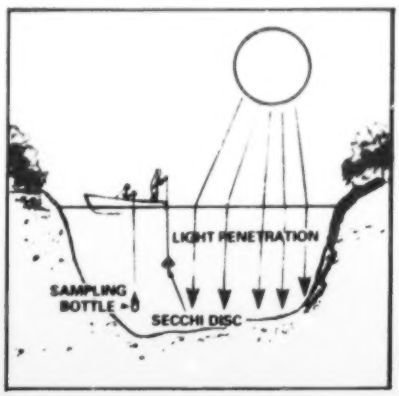
Ministry staff have been collecting this data from several Ontario lakes, and have developed a relationship between these parameters to help cottagers understand the processes and consequences of nutrient enrichment.

Using a Secchi disc is a simple way for cottagers to measure water clarity - and approximately estimate the degree of their lake's enrichment.

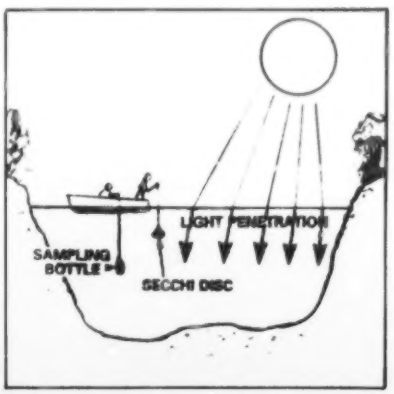
TABLE I: YOUR LAKE'S ENRICHMENT STATUS

	SECCHI DISC (S.D.) (depth in metres - m)	*CHLOROPHYLL a (Chloro-a) (micrograms per litre-ug/1)*
Enriched	*0-3 m*	*High Algal Density 4 ug/1 or greater*
Moderately Enriched	*3-5 m*	*Moderate Algal Density 2-4 ug/1*
Unenriched	*5 m or greater*	*Low Algal Density 0-2 ug/1*

N.B. This data does not apply to many northern lakes where water color limits Secchi disc visibility.



UNENRICHED LAKE



ENRICHED LAKE

In the absence of excessive colored matter (eg. drainage from marshlands), lakes low in nutrients are generally characterized by small amounts of suspended algae (i.e. chlorophyll **a**), and are clear-water lakes with high Secchi disc values.

What's a Secchi Disc?

A standard size metal disc is painted in black and white quarters and suspended by a rope from its centre. Cottagers can roughly measure water clarity by simply lowering this disc beneath a lake's surface and noting the depth at which it disappears from view.

Start your own Self-Help Program

Collecting this data is something your cottage association can do. It is part of the "Self-Help Program" started in 1971 in response to requests for water quality surveys from concerned cottagers.

Cottage associations are supplied with sampling kits that include a Secchi disc, a water sampler, sampling bottles and instructions. Cottagers are asked to take Secchi readings, and collect water samples biweekly during the ice-free season.

The water samples are mailed to the nearest Ministry of the Environment laboratory for analysis. Of course, the true value of this program is only realized if it's continued for a number of years so long-term trends can be monitored.

Table I shows how your readings and measurements can approximately be interpreted.

CHAPTER II

CONTROL OF AQUATIC PLANTS AND ALGAE

You've got extensive aquatic plant and algal growths in your lake. They interfere with boating and swimming, and may ultimately diminish shoreline property values. What are you going to do?

The answer may be chemical or mechanical controls, or habitat manipulation.

1. Mechanical Methods

Temporary control of aquatic plants may be achieved by removing the plants with rakes or dragging chains through the weeds. In some cases, small boat mounted cutters have been used.

Whatever the means, remember floating plant fragments may develop roots and grow elsewhere, or wash onshore and decompose. Cutting the vegetation without removing material often makes the problem worse.

On a large scale, harvesting and dredging machines may be used to remove vegetation from large areas; however, the cost and maintenance of this equipment is prohibitive for individual cottagers.

2. Habitat Manipulation

To develop a small swimming area, heavy-duty black construction polyethylene can be placed on the lake bottom to prevent weed growth. In sheltered areas of a lake, this can be accomplished by placing the sheet of plastic on the ice in late winter, and weighing it down with sand, gravel and small stones. When the ice melts, the plastic will sink to the bottom.

Once the plastic has settled to the bottom, it can be covered with additional sand. Numerous small air holes should be punctured in the plastic to allow gases that form on the lake bottom to escape.

Mechanical harvesting of weeds is often used to remove vegetation from large areas.

Individuals who have used this technique report mixed results. Wave action and traffic over poorly weighted plastic have caused it to shift and sometimes tear. Plants may also grow through the air holes or re-establish after a period of years on the overlying substrate, particularly if the sand contains organic matter.

Other habitat manipulation techniques, including dredging and water drawdown — lowering water levels over the winter to freeze and kill plants — have been tried with variable success.

Other vegetation control methods are being investigated, which largely involve habitat alteration to discourage plant growth.

3. Chemical Methods

Chemical control methods are currently the most practical for temporary control of weeds in small shoreline areas, considering the ease with which they are applied. However, the herbicides and algicides currently available usually provide control **for only a single season**, and sometimes less. The decay of dead vegetation will use large quantities of dissolved oxygen, reducing the amount that is available for a healthy fish population. (For this reason, mechanical removal of weeds is the better solution.)

Permits & Licences

It's obviously important to ensure that an algicide or herbicide which kills the nuisance plants, does not at the same time affect fish or other desirable aquatic plants.

Under The Pesticides Act, 1973 and Regulations, a person applying a pesticide directly to water must obtain a water extermination licence, and an aquatic nuisance control permit (unless exempt under the Regulations).

No licence or permit is required when the water body is totally enclosed by a person's property, i.e. no outflow.

The **licence** requirement ensures that pesticide applications to areas of significant size, which are accessible to the public, are made safely. Through the licencing system, a person may be educated on: the safe handling; correct storage and use of a pesticide; and on its impact on the aquatic media.

A **permit** authorizes use of a registered pesticide under specific conditions. **Permits** are issued on an annual basis by the Ministry of the Environment in co-operation with the Ministry of Natural Resources.

A cottage association proposing to control submergent aquatics in a bay or lake area fronting numerous cottages will require both a **licence** and a **permit**. An individual treating his own cottage frontage will require only a **permit**.

An aquatic nuisance control **permit** (issued for one year) ensures only that there will be no unreasonable infringements on the rights of other water users, and that the substance applied will not be toxic to humans, fish, domestic animals, or wildlife.

Through the **permit** system, the area of vegetation treated in any one lake may be regulated so that important fisheries and other wildlife habitat will not be significantly affected.

To secure a **permit** for applying a chemical or other substances to control nuisance conditions in any area of water, an individual or commercial agency must submit pertinent information on an official application form. In this way, the nature of a project and possible consequences may be evaluated.

Where to get Permits/Licences

Application forms may be obtained by writing the Ministry of the Environment, Pesticides Control Section.

An application should be submitted well in advance of the time that the chemical is to be applied. While every effort is made to process applications as quickly as possible, three weeks may be required for issuing a **permit** since it is often necessary to correspond with the appropriate District Office of the Ministry of Natural Resources, or to investigate the area.

Acquiring a **permit** or a **licence** does not absolve anyone from responsibility for undesirable effects arising from a treatment.

Anyone applying a substance without the authority of a **licence** or **permit**, or who violates the terms and conditions provided in a **permit**, is liable to a fine.

Types of Aquatic Plants

Aquatic plants may be divided into three categories:

1. Submerged rooted aquatics — which may have leaves that float on the water surface;
2. Emergent plants — which may have most of their foliar structures above the water surface; and
3. Algae — which color the water green or brown, or appear as "pond scum".

Aquatic herbicides vary greatly in the range of vegetation that they will control. It is therefore important to consult the label when control of a particular kind of nuisance species is desired. It is also very important to identify the species of vegetation present accurately as some plants are not controlled by any of the currently registered herbicides.

When to Treat

Algae and rooted submergent plants should be treated during the spring, or early summer, while the plants are developing rapidly, and before they reach nuisance proportions.

During this period, chemicals will provide more effective control and there will be less likelihood that fish will die as a result of shortage of oxygen, which can be one result of the decomposition of a large number of dead and dying plants.

Algicides and herbicides are generally more effective in warmer water, and better control will be achieved if the water temperature is over 18°C.

In many lakes, these temperatures are not reached until well into the summer months, after the time of optimum control with a herbicide.

However, since weather conditions (particularly the severity of winter and the rate of snow melt) will influence time of new growths of plants, it is important to: 1) monitor the site each Spring season; and 2) start your control program when the nuisance species are showing new growth. This may be early, mid or late June through early July.

Control of emergent vegetation should be undertaken about the time of flower or seedhead formation on days that are calm and sunny. Windy weather increases the hazard to the person applying the chemical and to nearby valuable plants.

If rain falls shortly after a spray is applied, it will wash the chemical off the plants, thus reducing the effectiveness of the treatment.

Read the herbicide label carefully to determine time and conditions of application, since each product behaves differently.

General Suggestions on Herbicides and Algicides

Before any chemical control measures are undertaken all owners adjacent to and in the general vicinity of the treatment area must be notified.

Due consideration must be given to any objections voiced by other parties who may use water from the surrounding area for drinking, swimming, fishing, watering domestic animals or irrigation.

Use of treated water following any application should be restricted according to directions from the manufacturer or chemical supplier.

Where fish are present and there is a heavy growth of algae or aquatic plants, the entire pond or bay should not be treated at one time. As mentioned previously, decomposition of a large plant mass can deplete the dissolved oxygen supply so that the fish will suffocate. Under such circumstances, several sectional applications should be undertaken, spaced about a week apart.

Where algicides or herbicides are actually mixed with or distributed throughout the water, it is important that the chemical be distributed evenly throughout the area to be treated. If localized high concentrations develop, fish and other aquatic life may be destroyed and control of the plants may be spotty. The amount of chemical applied should be in proportion to the depth of water to be treated. If there is an obvious current due to wind action, a larger proportion of herbicide should be applied to the upwind side of the treatment area.

All herbicides and algicides must be handled carefully because of their toxic properties and often corrosive nature. Closely follow the application instructions.

Facts on Chemicals

Information on specific herbicides and algicides has not been included in this publication since new products and changes in formulations are continually being developed.

The Ontario Herbicide Committee publishes recommendations each year in Publication 75 ("Guide to Chemical Weed Control") of the Ontario Ministry of Agriculture and Food. Pertinent extracts from this publication are available upon request from the Ministry of the Environment, Pesticides Control Section.

Further Information

Methods of chemical application, calculations of water volumes and dosage rates and illustrations to help you identify plants can be found in the booklet "AQUATIC PLANT AND ALGAE CONTROL".

Write: The Ministry of the Environment, Pesticides Control Section, Suite 100, 135 St. Clair Avenue West, Toronto, Ontario, M4V 1P5.

CHAPTER III

"THE ACID RAIN PROBLEM"

What is Acidic Precipitation?

Acidic precipitation, commonly referred to as "acid rain", kills aquatic life, erodes buildings and structures, and damages soils and forests.

Acid rain generally evolves through a series of four consecutive stages: (1) emissions of sulphur and nitrogen oxides, which originate chiefly from the combustion of fossil fuels (coal and oil); (2) long-range transport by winds; (3) transformation of chemical properties in the atmosphere to form acidic compounds; and (4) fallout of these pollutants to earth.

Fallout from the atmosphere occurs through either "wet deposition" precipitation in the form of rain, mist or snow, or by "dry deposition", such as fine particulate matter or dust that is absorbed on surfaces and becomes oxidized by moisture.

Sulphur dioxide (SO_2) emissions, largely from coal-fired electric utilities, smelters or industrial furnaces, account for roughly two-thirds of acidic pollution in North America. Nitrogen oxide (NO_x) emissions account for about one-third, half of which is thought due to motor vehicle combustion of gasoline.

Since the greater part of the world depends upon fossil fuel, it's not surprising that acidic precipitation is a world-wide phenomenon.

Concern and Effects in Ontario

Environmental scientists have known for several decades that atmospheric sources of acid had caused damage to lakes in Sweden, Norway and New York State. Environment Ontario studies in 1975 revealed that the Province was also seriously affected.

The areas of the Province most susceptible to acid rain are the central and northern parts because of their limited watershed buffering capacities. The buffering capacity is related to local geology, areas within the Canadian Shield dominated by granite bedrock rather than limestone. Many recreational lakes in Muskoka, Haliburton, Parry Sound and Algonquin Park will lose their fisheries if no abatement action is taken.

In addition, where acid rain falls on terrain with little natural buffering or neutralizing capacity, irreversible changes can occur in the soil, releasing certain nutrients, and also cause the leaching of heavy metals into watersheds, such as aluminum which is toxic to fish.

The situation is aggravated by the knowledge that particulates of certain metals, as well as ozone, known to harm the environment, are also transported great distances by prevailing winds.

Most at stake from acid rain is Ontario's, and Eastern Canada's, fresh water heritage. Acid rain threatens fish and other aquatic life by preventing successful reproduction. Tens of thousands of

Ontario's lakes are threatened and, of those already surveyed, about 250 are already acidified or extremely sensitive.

Pinpointing the Sources

In Ontario, most of the acid rain comes from United States sources. Because of tall smokestacks and prevailing weather conditions, the U.S. Environmental Protection Agency (EPA) acknowledges that Canada receives from the U.S. two to four times as much SO_2, and 11 times as much NO_X, as the U.S. gets from Canada.

Many of the emissions at the root of the problem are in violation of U.S. standards. Ontario and the Canadian federal government are concerned about a variety of current U.S. measures, involved with revisions to the U.S. Clean Air Act, which could permit new coal-fired power plants to increase emissions, and give individual states greater discretion in setting, or not setting, air pollution standards.

Through interventions with the U.S. EPA, U.S. Federal Court of Appeals, State and Congressional committees, Ontario and Canada have asked that U.S. standards be much more strictly enforced. These negotiations continue, while five working groups of Canadian and U.S. scientists, established under terms of the Memorandum of Intent signed between the two countries in August, 1980, to take strict measures to curb acid rain, continue their joint scientific investigations.

TABLE 1
SULPHUR DIOXIDE EMISSIONS NORTHEASTERN NORTH AMERICA

SOURCE	SO_2 EMISSIONS x 10^3 tons/yr. Urban	Utilities
CANADA		
Ontario	1,741.0	191.0
UNITED STATES		
Ohio	578.4	2,338.3
Indiana	433.5	1,666.4
Kentucky	74.2	1,387.7
Illinois	332.4	1,255.6
Michigan	189.4	1,158.8
Pennsylvania	535.5	1,119.6
West Virginia	149.7	1,020.9
Tennessee		721.4
Missouri	226.4	499.0
District of Columbia		216.5
New York	636.8	209.5
Wisconsin		192.1
Maryland	129.5	
Massachusetts	139.9	
Virginia	141.6	
U.S. Total	3,567.3	11,785.8

Table 1: Sulphur dioxide emissions for Northeastern North America.

The severity of the situation in Ontario, and the need for quick abatement action, results from the increase in acidity of precipitation over the past several decades. U.S. sulphur emissions from the electrical utility sector have nearly quadrupled over the past 25 years, and now account for two-thirds of U.S. total. And it is projected that 300 new power plants will be built in the U.S. during the '80s and '90s.

Acid rain has increased to the point where the average pH of rainfall for that part of Ontario lying south of the 50th parallel is less than 5.0 (see adjoining text" the pH parameter"). Many regions of the Province regularly receive rain of pH 4.0 to 4.5.

Ontario has taken strong steps to reduce its own emissions of acid-causing pollutants. Firm limits to emissions have been imposed on those industries and utilities which contribute most to the problem.

It is significant that in 1979, the United Nations Organization for Economic Co-Operation and Development (OECD) reported Toronto's air pollution from SO_2 and particulates as the least of any major industrial city in the OECD countries. That is a result of a decade of abatement action in Toronto, as well as in other industrial centres throughout the Province.

Acid Rain—the pH Parameter

Scientists gauge the acidity or alkalinity of a solution by a parameter called the pH, which is a logarithmic measure of the hydrogen ion concentration on a scale ranging from 0 to 14 (FIG. 3). On the pH scale, a chemically neutral solution has a value of 7, which is midway on the scale. The greater the acidity, the lower the pH value. A change of one pH unit downward implies a tenfold change in the hydrogen ion concentration, or a tenfold increase in acidity; a change of two is a hundredfold. If for example, a pH is 4, it is 10 times more acidic than a pH of 5; a pH of 3 is a hundredfold more acidic than a pH of 5.

Due to the carbon dioxide naturally present in the atmosphere, the pH of normal or "clean rain" in eastern North America is about 5.6.

In areas of southern Ontario, such as the Muskoka and the Kawartha Lakes, the pH of the rain is often found to be 4.5 to 4.0 range, meaning that the rain is many times as acidic as that of "clean rain". Aquatic life in susceptible lakes is considered to be vulnerable when the pH level of the lake lies in the range of 5.5 to 5.0.

There is widespread concern that if these acidic concentrations are sustained over long periods, serious detrimental effects will be experienced by aquatic and terrestrial ecosystems and these acidic effects will remain for years, or possibly become irreversible.

FIG. 1
The pH Acidic Parameter

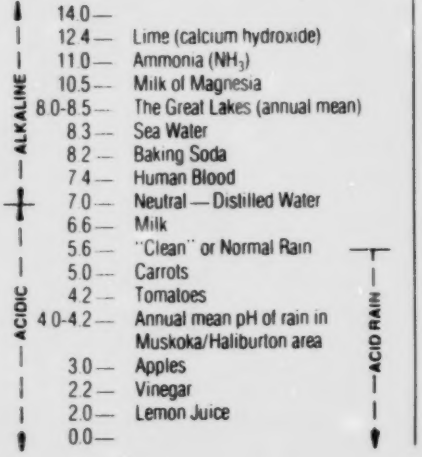
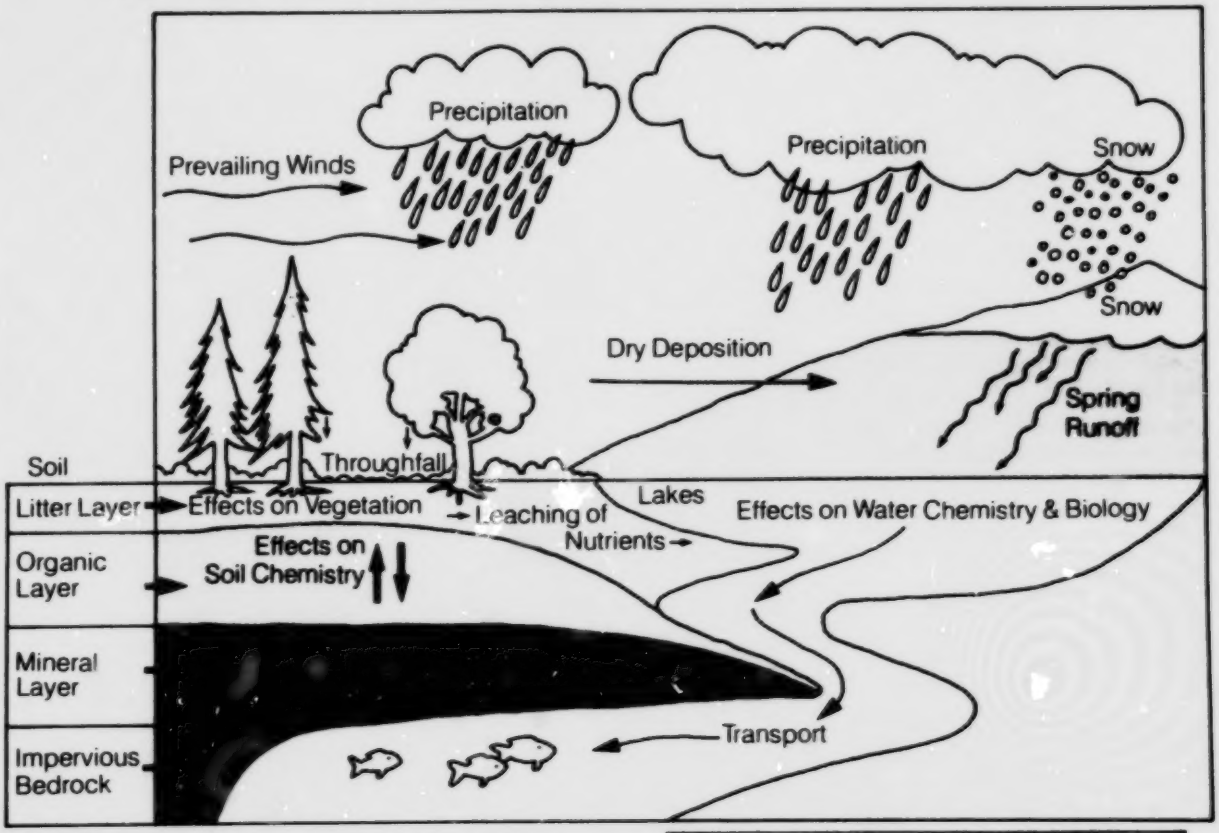
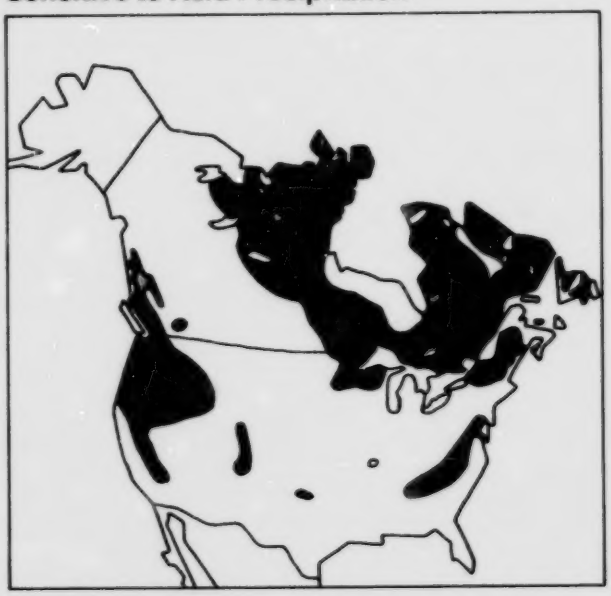


Illustration of Terrestrial/Lake Effects



North American Areas Containing Lakes Sensitive to Acid Precipitation



Source: James N. Galloway and Ellis B. Cowling, Journal of the Air Pollution Control Association 28, no. 3 (March 1978).

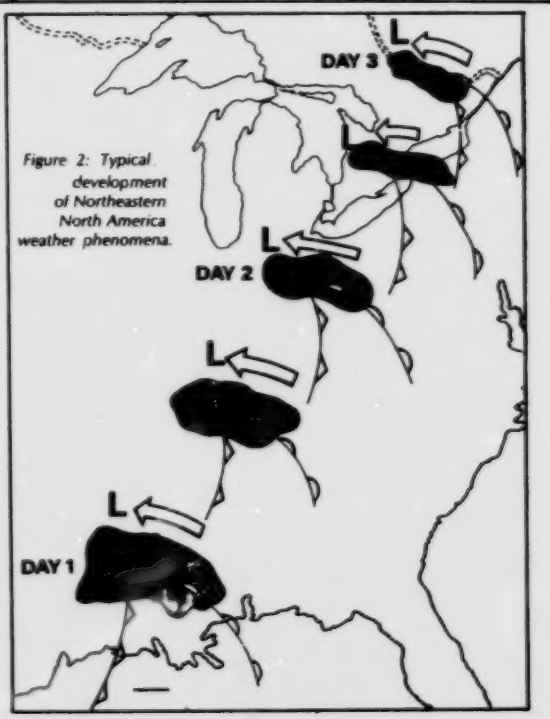


Figure 2: Typical development of Northeastern North America weather phenomena.

Solutions: Abatement the Only Answer

It is essential that Canada and the U.S. develop an effective mechanism to deal with the long-range transport of transboundary airborne pollutants. As the situation exists, if Ontario eliminated every source of sulphur and nitrogen oxides in the Province, it would have virtually no impact on the continuing damage to our lakes.

Moreover, as things now stand, we can expect more use of fossil fuels, especially coal and oil, and therefore more potential production of SO_2 and NO_x. In the future, we can only work for abatement at the international level, and continue to put in place scientific advances concerned with preventative and remedial technology and legislation.

For a better grasp of the phenomenom of acid rain and its effects, obtain a free copy of the booklet "The Case Against the Rain", subtitled "A Report on Acidic Precipitation and Ontario Programs for Remedial Action," produced by Environment Ontario. The booklet is available at all Ontario Environment district offices and the Ontario Government bookstore or by writing to the Information Services Branch, Environment Ontario.

Acidity Hotline Service: An Analysis of your Lake

How acidified is your lake?
You can find out -- simply by phoning (416) 965-7117 between 8:15 a.m. and 4:30 p.m. Collect calls accepted.

You have access to a continuing program - initially a survey of 1,665 Ontario lakes - that analyzes the susceptibility of lakes to acid attack.

Researchers are examining alkalinity levels in lake waters, a measure of a lake's natural, acid-neutralizing capacity.

Lakes vary greatly in their ability to neutralize acid loadings. Some can handle acid rain quite well, particularly those in alkaline soil or limestone deposit areas.

The application of lime to lakes has been one approach to combat the acid rain problem.

Lakes are listed as not sensitive, moderate sensitivity, low sensitivity, extreme sensitivity and acidified.

Lakes are arranged by county or district and listed alphabetically within each such division. Each listing includes: the location (township, latitude and longitude); the study or report providing the data; and the date of sampling.
Note that the five sensitivity categories are somewhat arbitrary; studies which can quantify acidification rates are not yet complete.

However, they are based on current understanding of lake sensitivity and provide a limited or preliminary answer to the question: Is my lake being affected by acid rain?

Further analyses of additional lakes will be released later.

A free fact sheet summarizing the latest information is available from: Information Services Branch, Ministry of the Environment, 135 St. Clair Avenue West, Sixth Floor, Toronto, Ontario, M4V 1P5, (416) 965-7117

Experiments on Acid Rain Lakes

A study is underway to assess the short-term effectiveness of lake neutralization.

The treatment program, directed by the Ministries of Environment and Natural Resources, is centred on lakes in the Muskoka/Haliburton and Sudbury areas.

In Muskoka and Haliburton, the study is one of the first attempts anywhere to protect artificially sensitive lakes that are not yet acidified.

In the Sudbury area, the program focuses on attempts to restore lakes that are already severely acidified.

This is research into a short-term and costly project, an interim step to buy time.

Research and caution are important so that damaging side-effects can be minimized.

Because of this, cottager assocations are not encouraged to undertake liming of lakes - until results of the experimental program are known.

For further information about neutralizing acid rain lakes, contact the limnology section of the Ministry of the Environment or the fisheries branch of the Ministry of Natural Resources in Toronto.

CHAPTER IV

PURIFYING WATER FOR DRINKING

Testing For Bacteria

In cottage country you're surrounded by water, and it looks clean. But can you drink it?

You have to remember that all water (from a lake, river or any other surface water source) is open to contamination by man, animal and birds — all of which can be carriers of disease. Consequently, **NO SURFACE WATER MAY BE CONSIDERED SAFE FOR HUMAN CONSUMPTION** without prior treatment, including disinfection.

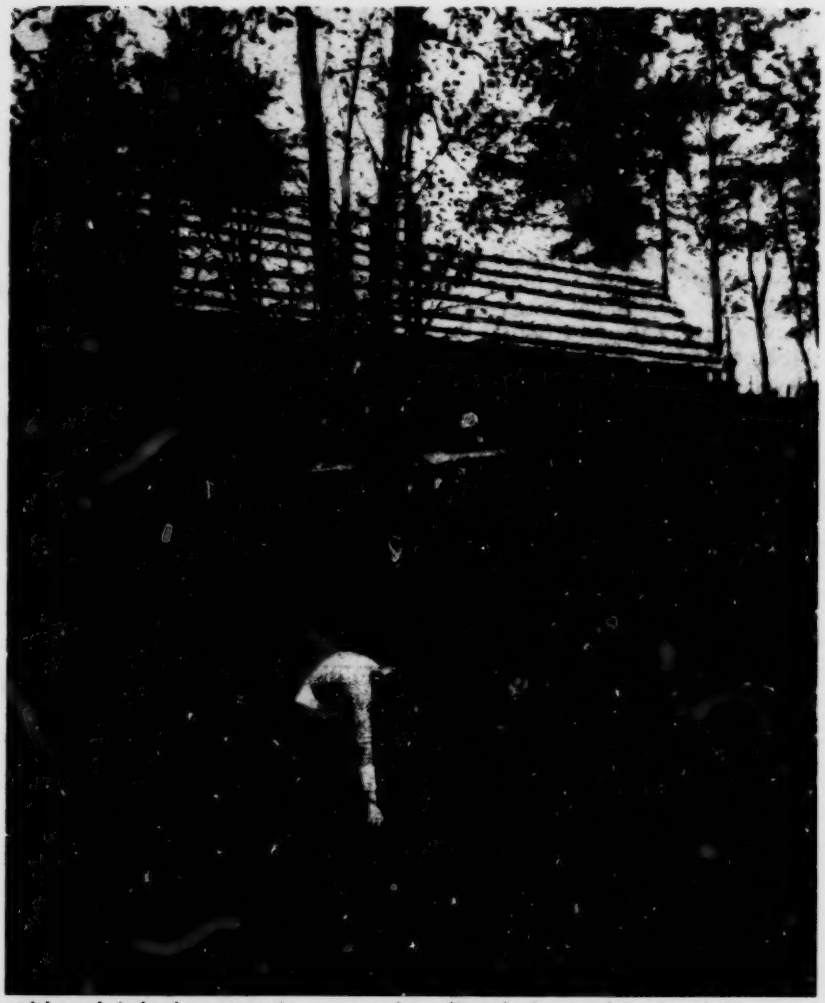
Only water that comes from a protected source such as a well, or that has been subject to some kind of treatment, is considered suitable for drinking. Unprotected surface waters are always considered unsafe, and samples from these sources should not be submitted unless some form of treatment has been first applied.

How is Bacteriological Safety Determined?

Drinking water is tested for the presence of two groups of bacteria, total coliforms and fecal coliforms. Total coliform bacteria are always present in animal wastes and sewage, but are also found in soil and on vegetation. Fecal coliform bacteria are only found in intestinal contents of warm-blooded animals.

The presence of fecal coliforms is more likely to represent sewage contamination, and is of greater concern because the risk of disease agents also being present in the water is higher. Fecal coliforms tend to die more rapidly outside the body, consequently their presence in water indicates relatively recent contamination.

No one should drink water containing fecal coliform bacteria in any number.



Although it looks romantic, water taken directly from a lake for drinking is not considered safe.

How Does Water Become Contaminated?

- By run-off or ground drainage seeping into unprotected surface waters or inadequately sealed wells and springs.
- By pipes and soil during construction of a new well. New wells should be disinfected before testing and use.
- By surface drainage and ground percolation into shallow dug wells that are improperly sealed.
- By sewage disposal systems close by or up hill from the water source.
- By pipes, pumps, aerators or splash preventers, non-sterile sample containers, dust and human hands.

Test Your Water

The Ministry of Health provides sterile bottles in which you can submit samples of your drinking water for bacteriological testing. The tests are performed without charge. To have a water sample analyzed, follow this procedure:

1. Secure a water sample bottle from your local Medical Officer of Health, or from one of the Public Health Laboratories listed at the end of this Chapter.
2. Fill the bottle with a sample of the water to be tested, following the sampling instructions given below.
3. Send the sample immediately, in the mailing tube provided, to:

   Public Health Laboratory
   Ontario Ministry of Health

   at the nearest location listed at the end of the Chapter.

A well supplying a summer cottage should be tested as soon as the cottage is opened each spring, and the water should not be drunk without treatment before the results of the test are obtained. In addition, a well should be tested once or twice during the season, preferably after heavy rains.

Sampling Instructions

To avoid contaminating the sample, keep the bottle unopened until the moment it is to be filled.

Also, never rinse it out before taking a sample. The bottle contains a preservative, essential to the keeping qualities of the sample, but generally present in so small an amount as to be invisible. Since this preservative dissolves in water, it would be lost if the bottle were rinsed before it was filled.

During the sampling procedure, neither the cap nor the neck of the bottle should be allowed to touch anything.

To take the sample, hold the bottle by the base with one hand, and remove the cap with the other. Continue to hold the cap, without touching its interior, while filling the bottle, then replace the cap without touching the neck of the bottle with your fingers.

How Many Samples Should Be Collected? . . .and When?

- Three samples with acceptable results collected one to three weeks apart indicate a safe supply. Once or twice a year after is sufficient, unless there has been some change in source conditions or physical appearance of the water.
- **Two or three samples at the cottage during a season, if all are acceptable for drinking.**
- From a new or repaired well after disinfection, and again one to three weeks later to confirm acceptable results.
- After any flooding or other changes that may have introduced contamination. If repeat samples show continuing contamination, some corrective action is necessary. Repeated testing alone will not provide a safe water supply.

Sampling from Taps

If you are trying to check the quality of the water supply itself, certain precautions are necessary to avoid sample contamination through the tap.

1. Remove any external fittings from the tap, such as an anti-splash nozzle or rubber tube.
2. Clean the tap nozzle carefully.
3. Turn the tap on full and allow the water to run for two or three minutes. This will flush the interior of the tap and discharge any stagnant water from the pipe.
4. Turn off the tap and dry the outer surface with a clean cloth. Take care not to touch the tap with the fingers during the rest of the sampling procedure.
5. Allow the water to run for a few seconds. Then fill the sample bottle from a gentle stream of water, taking care to avoid splashing.

Sampling from Wells

1. If the well has a mechanical pump, take the sample from a previously cleansed tap on the rising main, or from a nearby tap before the water reaches the reservoir or cistern.
2. If the well has a hand pump, pump the water continuously for at least five minutes before taking a sample. Then clean the mouth of the pump — and pump several more gallons of water to waste. Take the sample by allowing the pump water to flow directly into the bottle.
3. If the sample is to be taken from a well where water can be raised only by means of a bucket or a can, do not fill the sample bottle from this bucket. Rather, obtain a sample by lowering the sampling bottle into the water.

Treating Your Water

If you are not sure of the quality of the water, treat it by boiling or by chlorination. Never use untreated water for: drinking; brushing your teeth; washing dishes; or washing fruits and vegetables that are to be eaten raw.

Boiling

Heat the water to a rolling boil for at least five minutes to destroy any bacteria.

One disadvantage of boiling is that the gases dissolved in water are driven out resulting in a flat "boiled" taste. This can be removed, however, if the water is left to sit in a covered container (to prevent contamination) for a few hours. The taste can also be restored by pouring the water back and forth from one clean container to another.

Chlorination

Add a small amount of chlorine to the water to make it safe to drink. But note that solid particles in the water can shield bacteria from the action of the chlorine. If the water is cloudy, filter it BEFORE you chlorinate it.

1. **Chlorination in Batches**

Using a dropper, add eight drops of household bleach (4% - 5¼% available chlorine) to 4 litres of water; stir, and allow the mixture to stand for 15 minutes before using it. At the end of that time, there should still be a faint odour of chlorine left. If there is not, repeat the process.

This is a strong dose of chlorine, and it will make most water safe to drink. However, if the water does not need that much (i.e. if the "chlorine demand" is low) the chlorine not used up will leave a taste.

The water should have a slight chlorine odour. If the treated water has too strong a taste, it can be made more palatable by allowing it to sit exposed to the air for a few hours. You can also pour the contents from one container to another several times.

If the strength of the bleach is not 4% - 5¼% available chlorine (some labels may read "active ingredient Sodium Hypochlorite 5.25%") and you do not have a testing kit, calculate the number of drops required. Just divide 40 by the percentage of available chlorine in the bleach.

2. **Continuous Chlorination**

For continuous water disinfection, you may obtain a small domestic water hypochlorinator (sometimes coupled with activated carbon filters). These are supplied by firms listed in the Yellow Pages under "Water Purification."

Chlorine tablets can also be purchased with instructions on how to use them. If there are no instructions, then use one tablet for each quart or litre of water.

How to interpret a bacteriological report.

Remember that strict numerical limits for safety are difficult to establish, and that as the number of coliform bacteria increases so does the risk of disease agents being present in the water.

Coliform bacteria per 100 ml		
Total	*Fecal*	*Interpretation*
>160	*>60*	*Unsafe for drinking. This water is contaminated and should not be used for drinking under any circumstances. Do not attempt to apply these standards and interpretations to surface waters used for swimming.*
10-160	*1-60*	*Unsafe for drinking. Pollution source may be some distance from the water source, or diluted with large volumes of pure water, or the sample may not have been received within 48 hours of being taken. Samples older than 48 hours cannot provide reliable results.*
>10-160	*0*	*Unsafe for drinking. Contamination is not likely to be of sewage origin unless far removed from the water source or unless there has been a delay in receipt of sample. Common with new wells before disinfection and shallow dug wells which are not properly sealed.*
2-10	*0*	*Doubtful for a single sample, but safe for drinking if condition remains stable and supply is protected and located at least 30 - 40 m. from any source of human or animal wastes.*
<2	*0*	*Safe for drinking. Repeat samples may not show exactly the same results because bacteria are not distributed uniformly in water, contamination tends to enter intermittently and numbers can change during sample transit time.*
Est		*Unsafe for drinking. Number has been estimated due to some interference with the test. Exact number is not really critical, especially if in excess of limits shown above, for judging safety.*
O/G		*Doubtful condition and not recommended for drinking. No coliform bacteria could be detected because of "overgrowth" by other bacteria. This condition frequently occurs with new wells, dug wells receiving soil drainage, or wells which have been idle for sometime. Collect another sample and identify clearly "REPEAT SAMPLE."*

Lake Water

A lake, as already indicated, is subject to contamination at any time, either through natural surface runoff or through human intervention.

Common sense suggests that the water inlet should not be located near where people swim or where boats leak gasoline and stir up sediment. Private sewage disposal systems should be located far enough from the lake so as not to pollute.

Even with these precautions, however, never assume or depend upon the purity of untreated lake water.

Well Water

How Wells Become Contaminated

Well water is more reliable, but it, too, can easily become contaminated; regular testing is an essential precaution.

A well may become contaminated in one of two ways: the groundwater that supplies it may itself be polluted; or the well may admit pollution through faulty location or construction.

If the groundwater is polluted, continuous chlorination is essential to safety. If the groundwater is pure and the well is faulty, however, the fault can usually be corrected and the well disinfected.

How to Keep the Well Clean

Prevention: Pollution usually enters a well through the top. It may get in either directly, through a loose lid, or indirectly, by way of unsealed sidewalls. To prevent this sort of pollution:

1. Make sure that surface water cannot drain into the well. If the well is located in a dip of land, raise the top above the surrounding area so that the rim is well above the trickle level of even a heavy rainstorm.
2. Have the walls of the well sealed for a distance of at least 3-4 metres below the ground level.
3. See that the lid is sealed — around the rim of the well, around the pump base, and around the manhole, if there is one.

Cure: If the well is already contaminated, make the corrections suggested above before purifying it, or it will quickly become contaminated again, restoring the risk of disease. New wells, renovated wells, or wells upon which any construction work has been done, all should be disinfected before use.

How to Disinfect a Well

1. **Calculate the volume of water**

To calculate water volume, measure the depth of the water and the diameter of the well. The volume of water in Imperial gallons is then:

$V = 4.9 \times D \times D \times H$, gallons

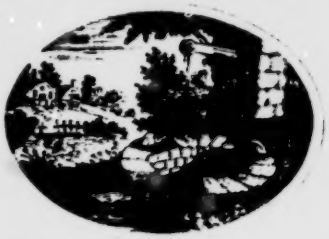
where D = well diameter in feet

H = water depth in feet

For example, if a well 3' in diameter and 20' deep has water within 5' of the top, the water depth is 15'. Then the water volume is:

Volume = $4.9 \times 3 \times 3 \times 15$
= 662 Imperial gallons

(4.55 litres = 1 Imperial gallon)



2. **Add chlorine**

For each 100 gallons of water in the well, add

(a) 6.6 oz. of calcium hypochlorite (7-8 oz. will do), or

(b) 6.62×16 = about 105 oz. of household bleach
= about 3½ 32-oz. bottles
= about 2½ to 3 quarts

For convenience, the tables which follow overleaf give the amounts of household bleach to be added to dug wells up to one metre in diameter or drilled wells up to 15 cm in diameter at various water depths.

NOTES ON CHLORINE USE

(a) If calcium hypochlorite powder is used, it should be mixed with water to form a solution before being added.

(b) With most drilled wells, the chlorine solution can be added through the vented sanitary cap.

(c) CAUTION — Any chlorine solution should be handled carefully. It can bleach clothing and injure the eyes and skin. In case of spills, wash off with copious amounts of water for at least 10 minutes.

3. **Let the chlorine work**

Stir the water if possible. If the water is piped to the house, pump the chlorinated water through the piping system. To be sure it disinfects the entire system, allow each faucet to run until you can smell the chlorine, and then turn it off. Let the chlorinated water stand in the well and in the piping system overnight (about 12 hours).

4. **Remove the chlorine**

Pump the water to waste until the well is dry or until no further odour of chlorine can be detected in the water at any of the taps.

5. **Take a sample**

Obtain a bacteriological sample bottle, take a sample at the tap (or the spout, if the water is not piped to the house), and submit it as described above for bacteriological analysis. Do not assume the water is safe until the laboratory results tell you so. Until the results come back, continue to boil or chlorinate the water before use.

6. **Repeat the test**

Have the water tested at intervals, as suggested above, to make sure that no further contamination has entered.

CHLORINE FOR DUG WELLS UP TO 1 METRE IN DIAMETER

Water Depth (metres)	*Household Bleach (litres)*
1.5	*.95*
3.0	*1.9*
4.5	*2.8*
6.0	*3.8*
7.5	*4.7*
9.0	*5.6*

CHLORINE FOR DRILLED WELLS UP TO 15 CM IN DIAMETER

Water Depth, (Metres)	*Household Bleach, (ml)*
7.5	*150*
15.0	*300*
22.5	*450*
30.0	*600*
37.5	*750*
45.0	*900*
52.5	*1050*
60.0	*1200*

Notes:

(a) If the water level is between two of the values given, use the chlorine dose for the higher water level.

(b) If you do not know how high the water stands in a drilled well, use the well depth to estimate the chlorine dose.

(c) These quantities are based on bleach with 5% available chlorine. If your bleach has a different strength, choose the correct amount of 5% bleach for your well size, multiply that amount by 5, and divide the product by the percentage of available chlorine in the bleach. The result will be the proper amount of bleach to use.

The Test for Chlorine

Where a chlorinator is used, it is essential to have a means of testing the amount of **free chlorine residual injected into the water**. A "D.P.D." chlorine testing kit should be used, which is available from most equipment suppliers.

The water supply should carry a free available chlorine residual of 0.2 to 0.5 parts per million, as determined by a test made after at least 15 minutes chlorine contact time. While the operation of the chlorinator is relatively simple, it is a good idea to ensure that the person who is responsible for the chlorination is familiar with both the operation of the machine and the required tests.

Water Treatment Devices for Home Use

Household water treatment devices that use any one of the processes below should produce bacteria-free water. Although no regulations currently exist to control the sale of these devices, guidelines were developed to protect the public. These were prepared by a joint voluntary government committee in co-operation with the Canadian Water Quality Association, whose members manufacture many of the devices on the market.

The following will help you assess the systems available.

I. Silver Impregnated Filters

POINTS TO NOTE:

1. A cracked or otherwise damaged filter may be ineffective. Care is required when handling, transporting, installing and cleaning any filter unit.
2. Filtration alone may be ineffective on certain raw waters. The following should be carefully considered if you wish to use this process.
   a) Bacterial levels should not be excessive. As a guideline, raw waters containing over 1000 total coliforms per 100 mL or over 100 faecal coliforms per 100 mL should not be treated by this process alone.
   b) Raw waters in which human pathogenic viruses are present should not be treated by this process either --unless it has clearly been shown that the filter will remove viruses. (Raw water that meets the guideline for coliform levels would normally not present a virus problem.)

II. Ultra-violet Irradiation

Preferred units have a device for monitoring or sensing ultra-violet transmission through the maximum depth of water in the chamber -- effective to meet the microbiological criteria. The monitoring or sensing device is designed to shut off the main-line valve during lamp or sensor failure, or if insufficient ultra-violet light is reaching the sensor.

POINTS TO NOTE:

The raw water to the unit must be of reasonable quality to ensure adequate treatment. The following conditions may make the unit ineffective:

1. Excessive bacteria.*
2. Excessive colour, turbidity, iron and/or organic impurities.*

The U.V. will work best where voltage or cycle variations do not exceed manufacturer's specifications. Remember, U.V. lamp output drops with age; the lamp should be changed regularly.

Ultra-violet treatment does not provide residual bactericidal action. A U.V. device should therefore not be used on raw, bacterially unsafe water without regular cleaning of the unit, as well as disinfection of the distribution system.

III. Iodine Feeders

Erosion-type feeders provide a dosage of saturated iodine sollution that will produce a continuous iodine residual of between 0.5 and 1.0 mg/L. They must also provide an iodine contact time of:

15 minutes for well waters
30 minutes for surface waters

POINTS TO NOTE:

1. The raw water to the unit must be fairly good to ensure adequate treatment. Watch for:
   a) Excessive bacteria.*
   b) Excessive colour, turbidity, iron and/or organic impurities.*
2. At low temperatures the disinfection rate may be lowered. A contact time of 30 minutes is therefore required -- especially in near freezing waters.

3. This device is recommended for cottages, summer camps, or resorts, and farm use only. The implications of its year-round use are still under study; much is unknown about the physiological effects of prolonged consumption of iodinated water.

IV. Chlorination

These devices are designed to provide a dose that will produce a free available chlorine residual of at least 0.5 mg/L. following a contact time of 20 minutes. A retention tank, in addition to a pressure tank, may be required to achieve this.

POINTS TO NOTE:

Again, the raw water must be of reasonable quality to ensure adequate treatment. Watch for:

1. Excessive bacteria.*
2. Excessive colour, turbidity, iron and/or organic impurities.*
3. A pH of 8 and above.*

NOTE: While chlorination is an accepted disinfection process, bacterial analyses must be made often to ensure safety.

V. Ozonation

1. These devices provide a small amount of free residual ozone to the treated water immediately after treatment. An ozone test kit for residuals in the range of 0.1 to 1.5 mg/L O_3 comes with each unit.

POINTS TO NOTE:

Once again, the following conditions may make the unit less effective.

a) Excessive colour, suspended solids (turbidity) and/or organic or inorganic impurities.*

b) Excessive dissolved iron, manganese or some organics may precipitate, thereby requiring post-filtration.*

Ozonation does not provide persistent residual bactericidal action. After a period of non-use, the distribution system should be disinfected with chlorine – prior to putting the ozone on-line.

VI. Distillation

POINTS TO NOTE:

During the distillation process, steam volatile organics in the water (e.g., phenolics) may be concentrated in the condensate. Claims for removal of such organics as chloroform, pesticides, herbicides, etc. should be backed by test data.

Contamination of distilled water in the reservoir may be a problem unless the reservoir is effectively washed and cleaned regularly.

Distilled water should be stored in non-metallic or special containers.

For more information, complete guidelines may be obtained from the Private Water Unit, Municipal & Private Section Pollution Control Branch, Ontario Ministry of the Environment, 135 St. Clair Avenue West, Suite 100, Toronto, Ontario M4V 1P5.

*Some of these problems may be corrected by pre-filtration, while others could require pre-treatment, possibly complex and expensive.

Sources of Sampling Bottles

Sterile sample bottles for submission of water samples may be obtained from any one of the following provincial public health laboratories.

LOCATION	*TELEPHONE*	*POSTAL ADDRESS*
Hamilton — Hamilton Psychiatric Hospital, 250 Fenneli Avenue West	416/385-5379	P.O. Box 2100, Hamilton, Ont. L8N 3R5
Kingston — Government Buildings, 181 Barrie Street	613/546-2686	P.O. Box 240, Kingston, Ont. K7L 4V8
London — London Psychiatric Hospital, Off 850 Highbury Avenue	519/455-9310	P.O. Box 5704,, Terminal A London, Ont. N6A 4L6
Orillia — Highway 11B South, 750 Memorial Ave.	705/325-7449	P.O. Box 600, Orillia, Ont. L3V 6K5
Ottawa —346 Moodie Dr.,	613/828-2442	P.O. Box 6301, Station J, R.R. 2 Nepean, Ottawa, Ont. K2A 1S8
Palmerston — Midwestern Regional Children's Centre	519/343-2015	P.O. Box 700, Palmerston, Ontario N0G 2P0
Peterborough — 1341 Dobbin Avenue	705/743-6811	P.O. Box 265, Peterborough, Ontario K9J 6Y8
Sault Ste. Marie —(Albert and Brock Streets) 160 McDougall St.	705/254-7132	P.O. Box 220, Sault Ste Marie, Ontario P6A 5L6
Sudbury — 1300 Paris Crescent	705/522-2640	Sudbury & District Health Unit, 1300 Paris Crescent, Sudbury, Ont. P3E 3A3
Thunder Bay — 336 South Syndicate Ave.	807/622-6449	P.O. Box 1100, Station F, Thunder Bay, Ont. P7C 4X9
Timmins — 67 Wilson Avenue	705/264-9571	67 Wilson Avenue Timmins, Ont. P4N 2S5
Toronto — 81 Resources Rd. Hwy. 401 & Islington Ave.	416/248-3163	Box 9000, Terminal A, Toronto, Ont. M5W 1R5
Windsor — 3400 Huron Church Road	519/969-4341	P.O. Box 1616, Windsor, Ont. N9A 6S2

CHAPTER V

TOILETS & UNSEWERED WASTE DISPOSAL SYSTEMS

What To Do With Your Sewage, etc.

With more than 300,000 cottages in Ontario, it's not surprising that the disposal of human waste is one problem all cottagers have in common.

Where toilet facilities can be connected to municipal sewage systems, the solution is obvious.

But in most cases municipal services are not provided. The alternative is a good septic tank system or a system using an approved aerobic packaged plant. These systems are capable of treating all the sewage from a cottage residence.

Class 1 Sewage Systems

There are other types of sewage systems in use in Ontario that may be used **under certain circumstances** to treat a portion of the sewage generated. Various types of unsewered toilets (earth or pit privies; vault privies; removable pail privies; chemical toilets; incinerating and composting toilets) are used to dispose of human waste only, and are collectively called "Class 1 Sewage Systems".

They are usually used because of their simplicity and low installation costs. When properly installed, used, and maintained, they can give good service without damaging the environment.

Separate System for Grey Water

When a "Class 1 Sewage System" is used, a separate sewage system is needed to dispose of the waterborne sewage from the kitchen sink, baths, showers, laundry, etc., which is frequently referred to as "grey water".

But where the water system is pressurized, a soak or leaching pit is generally inadequate and a septic tank or aerobic system is needed. Under these circumstances the cottager will frequently use the septic system for all the sewage unless the the water supply is very restricted.

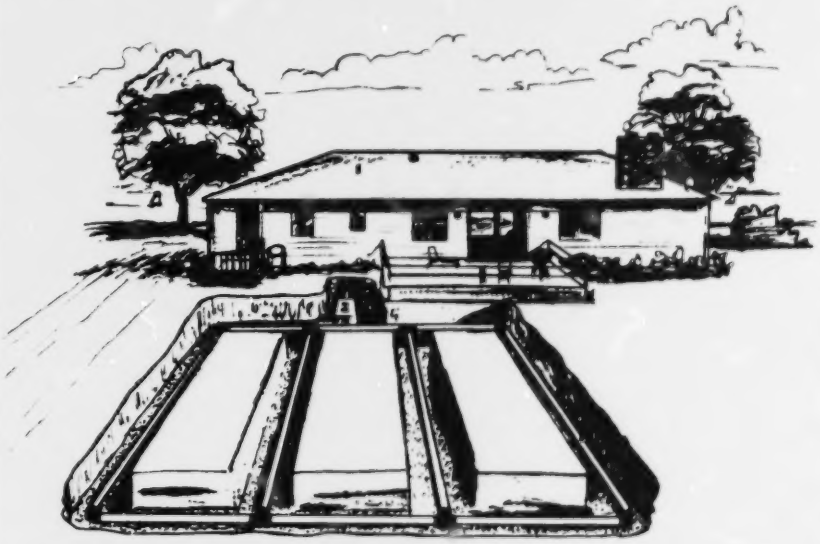
Providing the quantity of grey water is low, **as in a cottage without a pressure water system**, a soak pit or "Class 2 Sewage System" may be used.

The Septic Tank System

What Does it Do?

Where you can't hook onto the municipal sewers, a septic tank system is a good choice. It consists of a septic tank to settle the solids out of the sewage, followed by an underground leaching bed in which the sewage is treated and dispersed in the soil.

The big advantage of this system is that it will accept all household



Typical lay-out of septic tank tile bed system.

SOLUTIONS MAY VARY

Please note: the disposal methods described in this chapter are not equally acceptable everywhere. Local by-laws, as well as soil conditions may rule out some methods.

Note also all figures, specifications, etc., mentioned in this Chapter are for guidance only. To find out which forms of sewage disposal are approved in your area (and details of the Regulations), contact your local staff at the Ministry of the Environment, or Health Unit. See Chapter 12 for offices nearest you.

All sewage disposal installations require approval except — "Class 1 Sewage Systems".

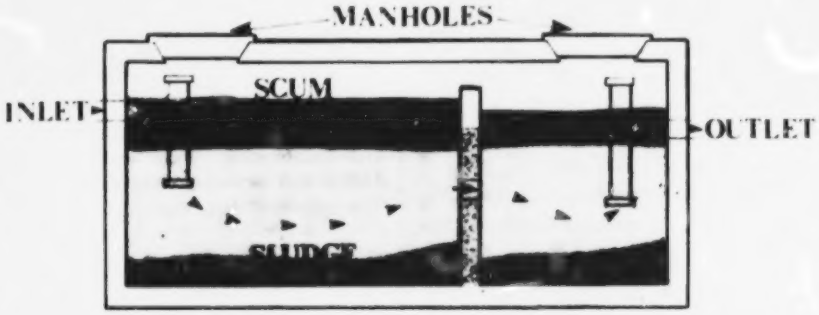
wastewater: from the bath, the dishwasher, and washing machine, as well as the toilet.

If treated with reasonable consideration, a septic tank system will accept all these waste waters without complaint for several years — until it's time to pump the accumulated sludge out of the tank. If the system can be treated so that the sewage flows by gravity to the tank and then to the leaching bed, it needs no machinery or power, and (apart from pumping out the tank occasionally) little maintenance.

How Does it Work?

The only way to dispose of sewage, as distinguished from merely sending it somewhere else, is to prepare a comfortable home for the micro-organisms that eat it.

Many strains, often known as "bugs", perform this useful function. They can be divided into two groups: the aerobic ones, which need oxygen, and the anaerobic ones, which can't abide it.



Cross section of the actual septic tank.

The Septic Tank

Anaerobic bacteria live and work in the septic tank, which is just that: a tank. It's usually big enough to hold several days' worth of sewage, and is shaped so that the flow is slow and reasonably uniform.

Sewage from the cottage enters the tank where the solids settle to the bottom as a sludge, fats and greases rise to the top to form a scum. The sludge gets partly decomposed by the anaerobic bacteria. If the system is working well, the liquid portion that flows out of the tank is relatively clear, although it still has an odour, and may carry disease.

It shouldn't go anywhere but into the leaching bed (or equivalent treatment facility). **Never into a ditch or watercourse!**

The Leaching Bed

A leaching bed of the trench type consists of two or more rows of buried distribution pipe, each row of which is set in a bed of ¾" stone in a trench. Such beds are frequently called "tile" beds. Earlier practice, which is still permitted, was to use lengths of clay or cement pipe about 30 cm long called "tiles" which were set in a row 6–12 mm apart allowing the sewage to flow into the stone layer. The distribution pipe now commonly used is plastic pipe and is perforated with small holes (usually at the 4 and 8 o'clock position) along its length. The stone layer acts as a reservoir from which the sewage can seep slowly into the soil.

The dimensions of the trench and the details of how it should be filled in, the characteristics of the soil, the required length of the distribution pipe, and other particulars of the burial are important, and are specified in Ontario Regulation 374/81.

Sewage leaving the septic tank flows down the rows of distribution pipe, leaking continuously into the soil through the holes or gaps. In the soil it encounters a flourishing population of aerobic bacteria which finishes the good work begun in the tank by the anaerobic "bugs".

An alternative to the conventional or trench type of leaching bed is the filter bed. This is a leaching bed in which the sewage from the treatment tank is spread evenly over the surface of a sand filter by a network of distribution pipes which are set in a stone layer continuous over the area of the filter sand. The regulation specifies the sand that is acceptable and it is important that only an acceptable sand is used. The filter medium must be at least 0.75 metres deep. Depending on the nature of the underlying soil the filter medium may have to be extended at its base to provide a suitable contact area. Full particulars are in the regulation and should be obtained from the health unit or Ministry of Environment office. The only advantage of a filter is that it requires less space than a trench type bed and can be used providing the underlying and surrounding soils can disperse the bed effluent.

Leaching Bed Design

Under normal conditions the ideal location for a leaching bed is in a well-drained, sandy loam soil, remote from any wells or surface water. For the leaching bed to work satisfactorily the maximum elevation of any rock formation or layer of impervious material should be at least 0.9 metres below the elevation of the bottom of the absorption trenches, or the surface of the filter medium.

Where water table is the limiting factor, it is the highest water table that is of concern rather than the average or that found at the time of site investigation. The minimum separation between highest water and the surface of a filter or the bottom of an absorption trench is 0.5 metres.

Trickle discharge from the tank to the bed is permitted for trench type leaching beds with up to 150 m of distribution pipe. If the land is sloping, a pump may be used to lift the effluent to a point where gravity flow will resume. A minimum of 3" ϕ trade size must be used for gravity flow systems and 1¼" ϕ trade size pipe for pressure systems. For trench type leaching beds having more than 150 m of distribution pipe, dosing of the bed by siphon or pump is mandatory.

The maximum length of any single absorption trench in a trench type bed is 30 m.

Beds on Sloping Sites

Leaching beds constructed in the conventional manner require sites that are level, or only slightly sloped. The economics and other problems of levelling the required area will generally limit conventional construction methods to slopes of not greater than 1 foot in 10 (10%).

Special installation methods are required for more steeply sloped sites. Information on these may be obtained from Ministry or Health Unit offices and may be used in slopes from 10% up to 25% (1 in 4). Leaching beds are not to be constructed on areas where the slope exceeds 25% in any direction.

Raised Leaching Beds

In cases where 0.9m of acceptable soil is not available under the pipe trenches above rock or impervious soil, a raised leaching bed may be built. Selected material is used to form a mound in which the absorption trenches can be set so that the desired 0.9m clearance below the trenches is obtained. An "impervious" soil is one having a percolation rate in excess of 50 minutes/cm.

A soil mantle of percolation time between 1 and 50 min/cm and at least 0.25 metres in depth is required beyond the outer pipes in any direction that the effluent from the bed will move in the soil. If the percolation time of the in place soil is 15 min/cm or less it can serve as the mantle. If it is over 15 min/cm it will normally be necessary to add soil to form the mantle. This will be so in all cases if a filter bed is used and, in the case of trench type beds, where the percolation time of the fill imported to form the leaching bed is less than 75% of the percolation time of the soil on which the fill is placed. The soil surface should also be planted for stability.

Clearance distances outlined in the following section must be increased by an amount equal to 2 units horizontal for each unit vertical height of the surface of the leaching bed above natural grade.

Soil Assessment

The suitability of the soil for absorbing the liquid waste depends on such characteristics of the soil as its grain size and gradation, the presence of organic compounds, its structure, density, moisture content, "plastic" properties and chemical composition. These characteristics must be assessed and a judgment made on the percolative capacity of the soil for handling septic tank effluent.

To make this assessment an inspection must be made of the property. The result of the inspection and any soil testing is the selection of a percolation rate, "T" time, expressed in minutes.

Tank and Tile Bed Location

In locating a septic tank system all clearances are to be measured horizontally.

A septic tank should not be closer than:

- 15m to any well, lake, river, stream, water course, pond, spring or reservoir.
- 1.5m to any building or structure.
- 3m to any property boundary.

The distribution pipe in a leaching bed shall not be closer than:

- 15m to a well which has a solid watertight casing to 20 feet below ground.
- 30m to a spring or well other than a well with a watertight casing to a depth of 20 feet.
- 5m to any building or structure where the bottom of the perforated or open jointed pipe or the tile is below the level of the lowest floor.
- 3m to any property boundary.
- 15m to any lake, river, stream, water course, pond, spring or reservoir.

The above distances are a minimum according to the Regulation. They may have to be increased to prevent pollution if soil or other site conditions dictate.

Operation and Maintenance

Various preparations are on the market which are said to start, accelerate or improve the action in the septic tank. But there should be no need to add any such product since all the necessary bacteria are already contained in the sewage entering the system.

With the tank capabilities listed in the following table, it should not be necessary to pump out the tank more than once every three years. It should, however, be inspected at least once a year and pumped out if necessary. Failure to pump out a septic tank when required will result in sludge or scum being carried into the leaching bed, which in turn may clog and cease to function. In this event not only will the tank have to be pumped out, but the leaching bed may have to be replaced.

TABLE NO. 2
SEPTIC TANKS WORKING CAPACITY
HOUSEHOLD SYSTEMS

Number of Bedrooms (2 persons per bedroom)	*Minimum Total Working Capacity Litres**
2 or less	*2700*
3	*3600*
4	*4500*
5	*4500*

**4.55 litres = 1 Imperial gallon*

Other Things to Watch For

A leaching bed can be damaged by vehicular traffic, or blocked by excessive root growth, and freezing. Moreover, snowmobiles driven over leaching beds destroy the natural insulation provided by the snow cover and allow frost to penetrate the bed, especially where it is used intermittently (e.g. on weekends only) during winter. Local pump-out contractors or your local authority can advise on the need to pump out septic tanks not used in winter.

The Drawbacks

There are few disadvantages to the septic tank system (apart from its cost), and even that may not compare too badly with the cost of other approaches since the system handles all household wastes.

Its major drawback is simply that it can't be used everywhere. An impermeable soil, such as clay, won't let the liquid flow through it; a shallow soil hasn't the necessary capacity; and a very cold climate may not suit the indispensable bacteria. Consult your local Environment staff or Health Unit.

Also, remember access by road or boat is required for pump-out servicing.

Aerobic Systems

These systems are, in many ways, similar to septic tank systems except that the "anaerobic" septic tank treatment is replaced by an "aerobic" treatment facility.

Although these aerobic units are usually more expensive than septic tanks, they often give a purer effluent. For this reason, in comparison with a septic tank system, less distribution pipe is required in a trench type leaching bed, and in a filter type bed a smaller area is permitted. This often means, for example, that trees which would have to be cleared for a septic tank system may be saved if an aerobic system is used.

This method features an aeration tank, and can accept all household wastewater, not just the toilet wastes.

The system is, in effect, a small activated sludge plant, similar to the secondary treatment plant of many municipal sewage works: air, vigorously stirred or bubbled into the wastes, nourishes aerobic bacteria, which break down the complex organic compounds of the wastes into simpler, inoffensive ones.

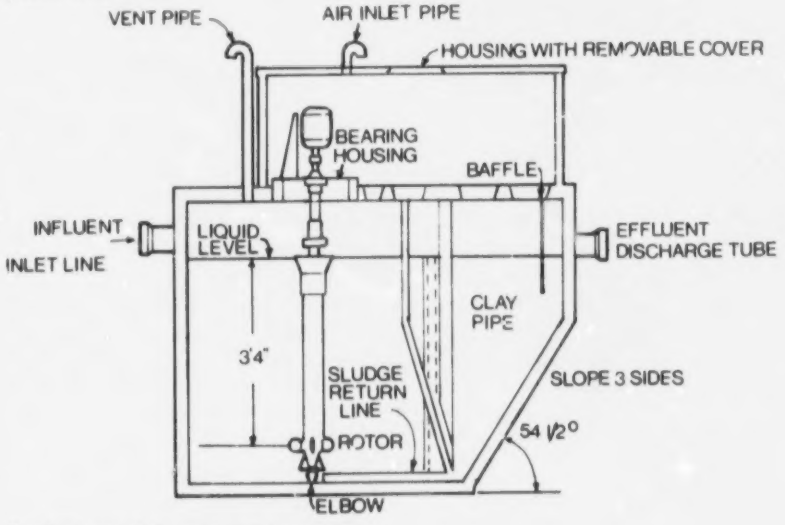
The products of their labor are a reasonably clear liquid and sludge. The liquid is discharged to a leaching bed. While the sludge, like sludge from a septic tank, must be pumped out periodically and disposed of in a manner approved by the Health Unit, or Ministry's District Office.

Toilet Systems

It should be stressed that the following "solutions" to toilet waste disposal may be unacceptable in many parts of Ontario because of terrain.

In any event, they are only suitable for primitive cottage installations — and aren't usually approved for cottages with running water.

These systems are usually unacceptable for new cottages.



Typical aerobic treatment system.

Privies

Pit Privy

A pit privy is a hole in the ground, fitted with a seat for comfort and a shed for privacy.

It is justly popular for its simplicity, and it is widely used.

Despite this simplicity, a privy must be planned.

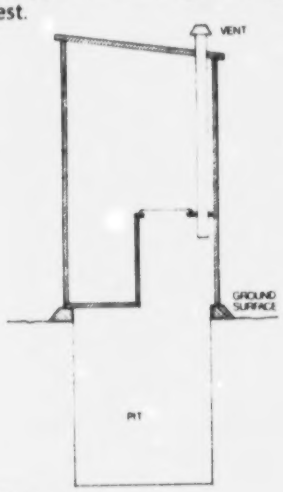
To begin with, the pit should be large enough to last at least five years before it fills up.

For sizing a privy, based on year-round family use in well-drained soil, estimate 60 dm^3 per person per year. Bear in mind that this figure may not apply to camping conventions or busy resorts, where the pit may fill too fast for normal drainage and decomposition.

Build the shed stoutly, include a window, and assemble screens to keep out flies, rodents, and other carriers of filth. Metal sheathing on the outside walls may discourage those porcupines!

Don't neglect to vent the pit. Fresh air and foul should balance themselves somehow, through a good-sized vent pipe, (or preferably two vent pipes), rather than through the seat.

A screen on the top of the vent pipe will discourage flies, and a little raised roof (not a lid) will keep out the rain. The Ministry of the Environment supplies a working drawing on request.



Pit Privy.

Well-vented and considerately used, a privy is reasonably inoffensive and should not cause odour problems.

Consider also the soil in which the pit will be dug. There must be enough of it to surround the pit with two feet of earth in all directions, around it as well as below it.

And the soil must have the right composition. If it's too sandy, the walls of the pit will have to be shored to prevent cave-ins. If it's solid clay, the liquids will just sit.

Ideally, the soil should be: porous enough to permit liquid to seep through it; tight enough to keep liquids from running through too fast; and deep enough so that there will be at least 0.6 m of it below the bottom of the pit before you reach rock, an impervious soil layer, or water table.

(The "groundwater", incidentally, is the water that saturates the ground beneath the surface. This water feeds springs and is tapped by wells. The "water table" is the top level of the groundwater.)

The ground should slope away from the hole on all sides. Do not dig your pit in the centre of a drainage basin. Also build a low mound around the privy to keep out rainwater runoff.

Be sure you stop digging the pit two feet above the water table. Remember that it varies during the year — higher in wet weather and lower in droughts. Check the level shortly after the spring thaw.

A final safety note: don't let a small child use the privy unattended.

Pail and Vault Privies

Variations on the privy theme include the pail privy and the vault privy.

These differ from the self-contained pit privy in that neither of them ultimately disposes of the wastes, they merely collect them and postpone the problem.

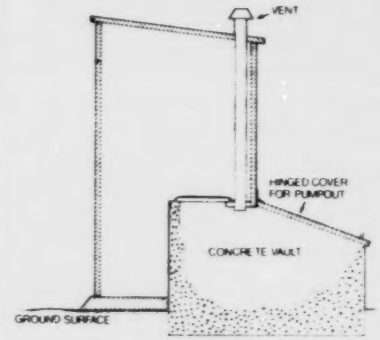
The pail privy substitutes a pail for the pit, while the vault privy uses a small holding tank, the "vault". (The latter, in lightweight plastic, is often encountered at construction sites and club-houses.)

The pail or vault privy will need to be emptied periodically. It is permissible to dispose of the contents into a cesspool constructed on the property.

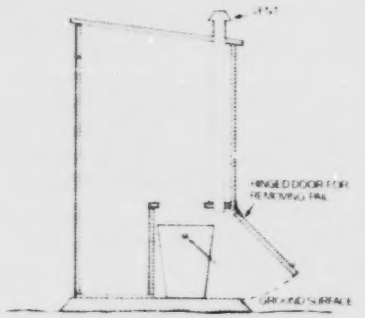
A cesspool, known as a "Class 3 Sewage System", is similar in construction to a "Class 2 Sewage System" or leaching pit. The difference is that a "Class 3 System" may only receive human waste from a "Class 1 System" whereas a "Class 2 System" is only for non-human waste. **A cesspool requires the approval of the authorities and must be constructed to meet the standards of the Regulation.** The clearance distances from a cesspool to wells, surface waters, etc., are contained in the Regulation, and exceed those of a leaching pit.

Waste from a pail privy may be dumped into a cesspool. But this will be more difficult in the case of the vault privy which is generally emptied by a contractor who pumps contents into a tank truck for disposal elsewhere. The contractor must be licensed by the Province and have a Certificate of Approval for the final disposal of the sewage, approved by the authority.

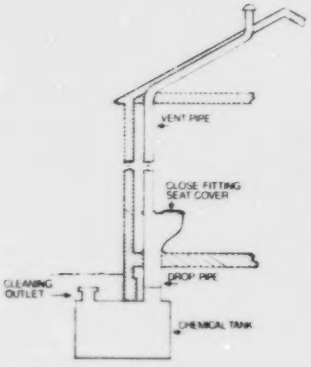
Unless suitable soil is a long walk from the house, you're better off with the pit privy, but if the choice is between a pail privy or a vault privy, the vault is the better choice. The pail is cheaper, but you may not enjoy carrying it!



Vault Privy.



Pail Privy.



Chemical Toilet (Drop Type).

Chemical Toilets

The simplest chemical toilet is a bucket with a seat. The "chemical" part is a small amount of solution poured into the bucket before use.

It can act in one of three ways: as a caustic, a preservative, or a dye. Accordingly, it may decompose the wastes, preserve them, or merely improve their appearance.

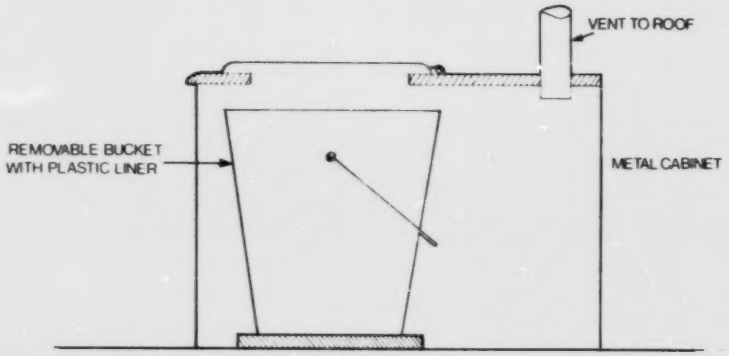
The first two kinds of chemicals make the wastes harmless. The caustic, usually caustic soda or lye, liqui-

fies and partly decomposes the wastes. At the same time it kills bacteria present and destroys parasite eggs, a significant feature in controlling disease.

A chemical preservative, such as formaldehyde, also destroys bacteria present; however, it prevents the wastes from decomposing.

Killing bacteria reduces the odours typical of the washroom. To further the good work, many chemical charges also contain a perfume, and possibly a blue or green dye to mask the yellow-brown colour imparted by nature.

Killing the bacteria also means that a chemical toilet (using either a caustic or a preservative) may safely be located in the cottage.



Chemical Toilet (Bucket Type).

If the chemical charge consists of only dye and perfume, and lacks either kind of bactericide, the improvement in appearance is deceptive.

The drawbacks: The chief disadvantage of the chemical toilet is that, like the pail and vault privies, it does not solve the problem; it merely gives you time to think about it.

Using a chemical disinfectant is also a coin with two sides. The same chemical that so conveniently inhibits decomposition during use continues to inhibit it afterwards; and disposing of wastes must ultimately take place through bacterial decomposition.

A chemical toilet may discharge through an overflow, or be otherwise emptied, into a cesspool. Otherwise it must be periodically pumped out by a service contractor in the same manner as a vault privy. Even if a cesspool is used, periodic cleaning out of settled solids and removals of a pump-out contractor is required.

The best option may be to dispose of the wastes by hauling them to a municipal sewage plant, provided the plant is big and the chemical toilets few. A big plant, with other contributions pouring in, can dilute the chemical mix to the equivalent of raw sewage and then treat it along with the rest. If too many people get the same idea, however, the chemicals could stop the bacterial action of the sewage works. For the same reason disposal of chemical toilet waste into a septic tank has its drawbacks. Although this is acceptable if the quantity is small in relation to the other flows into the tank.

1. **Bucket**

The basic version of the chemical toilet is a simple bucket, often fitted with a removal plastic liner and placed in a small, vented metal cabinet in the bathroom.

The approach is simple, and the unit is odourless when properly installed and operated.

On the debit side, the contents of the bucket are open to view at all times. Furthermore, when the bucket is more than half full, a user could be splashed with caustic, which burns, and dye, which may stain clothing.

There is also the problem of the full bags which must be removed at the proper time, and their capacity is limited. If their owner gives a party, for instance, they may not last the evening. They must be taken to an approved dumping place, and steps must be taken to prevent punctures.

2. **Splash Pan and Drop Pipe**

Other models of the chemical toilet offer refinements to the basic concept.

A splash pan is available, shaped like the bowl of the standard flush toilet, which prevents all but a rare splash. To allow room for the splash pan, however, the bucket containing the charge becomes a small tank (the plastic bag is no longer used) and the contents of the tank must be drained at intervals to a "Class 3 System" or pumped out. The installation is subject to all the local restrictions on holding tanks.

Another version locates the toilet over a tank buried in the ground beneath the cottage. The connection is usually made by a drop pipe, and the drop is usually sufficient to eliminate the need for a splash pan. The tank must be pumped out at suitable intervals, and the contents disposed of according to local bylaws.

3. **Recirculating**

The recirculating chemical toilet is similar to the splash-pan toilet, except that it uses the contents of the tank to flush the bowl.

The contents are liquified and dyed blue by the chemical charge. The unit is designed to eliminate splashing, and is aesthetically much like the standard flush toilet. (This is the toilet of the aircraft washroom). The need for a recirculating pump, however, increases the cost of this unit; it also may limit its use to areas where electricity is available. Although some units can be operated with a hand pump.

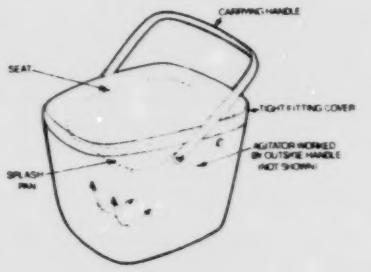
4. **Portable**

A useful variant on the chemical toilet is the portable model. This is much like the basic bucket model, though it may have a splash pan and is fitted with a fairly tight lid and carrying handle.

It must be carried with some care to avoid splashing or spilling. Its capacity is, of course, limited by the need for portability, and the usual requirement for safe disposal of the contents.

These units may be drained into a standard toilet and flushed to municipal sewers or to a septic tank, providing the quantity is limited in comparison to other flows received by the tank.

Incidentally, while looking at portable toilets, consider weight and stability. By the time it's ready for emptying, the toilet may weigh 30 - 35 kilograms; for many people, that's a lot to lift. Also, some models are unstable and may need a frame for convenient use by children or older people.



Portable Chemical Toilet.

Incinerator Toilets

In these units, which may be heated by either gas or electricity, the wastes are burned to a dry, sterile ash, which may be discarded with no special precautions. The toilet is thus a self-contained unit requiring no further equipment for disposing of wastes.

The toilet consists of the incinerator unit, the necessary insultation, and the stack to lead combustion products away. Operation may require burning after each use, or permit storage of sewage for incineration at a more convenient time. In the former type the burning cycle may be interrupted at any time for further use, but the frequency of interruptions is limited by the "storage" capacity of the equipment.

Toilet wastes are mainly composed of water. Consequently before the solids can be burned they must be dried. The drying process is one of boiling and this, as well as the actual incineration, may create odours. Good design, high combustion temperatures and the use of catalysts are used to overcome this problem.

In a well designed system the end product is a light ash which may be easily removed either by a vacuum cleaner or by removing the ash pan and dumping the contents. Operating costs of course include the electric power or gas used in incineration. As with other forms of toilets the advantages and disadvantages should be considered in light of the individual circumstances and preferences.

Only toilets whose electrical or gas burning components have been approved by the Canadian Standards Association, the Underwriters Laboratory of Canada, or the Canadian Gas Association should be used.

Composting Toilets

A comparative newcomer to North America, the composting toilet has been available for some years in Scandinavia. Its principle is simple. Like the compost heap in the garden or the manure pile beside the barn, the composting toilet allows organic materials to decompose in the presence of air. When fully composted the residual material is an inoffensive earth-like substance which can be used as a fertilizer. Unfortunately not all toilets of this type will produce a fully composted end product.

The toilet of a large unit is located in your bathroom, connected by a drop pipe to the tank directly below.

If your cottage does not have a basement, particularly if you're on thin soil, you have a problem.

Odour is eliminated, in principle, by an insulated vent pipe connecting the interior of the tank with the out-of-doors. When all goes well, this vent is not merely a passive conduit, but a chimney. The composting material in the tank is warm, as are the water vapor and carbon dioxide rising from it.

Since warm air rises, the warm gases in the toilet flow upward and out through the vent, creating a partial vacuum within the composting tank. This vacuum draws replacement air into the tank from two sources): 1) an air intake, designed to flow air through the wastes and keep them aerobic, and 2) the toilet seat, when the lid is up. The slight downdraft through the toilet seat also prevents odours from reaching the bathroom.

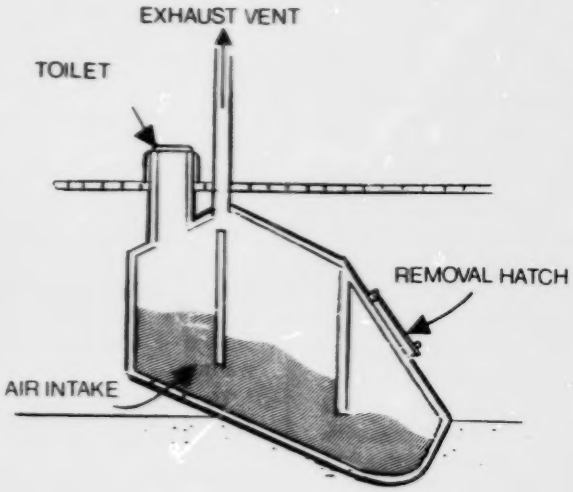
Garbage Disposal Too?

The problem with some units is the lack of aeration and excess fluids. Toilet wastes alone, even if mixed with toilet paper, tend to pack so tightly that it is difficult to pass air through the mass. An excess of urine (high in ammonia content) in relation to the carbon content of the composting mass, produces a carbon/nitrogen (C/N) ratio too low for good composting.

To overcome this difficulty, some units have special aerating pipes. In other units the proper conditions for good composting may be obtained by adding fluid absorbing material to improve the process of decay. If this material is rich in carbohydrates (kitchen refuse, paper, leaves, grass) positive effects are obtained in all respects. A better ventilation is obtained as the excess fluid is absorbed and the mass made more permeable to air. The aqueous content is stabilized and is less influenced by load variations. Also, decay is influenced favourably — through a better C/N balance.

During the period while the tank is filling, there may be too little compost to absorb the liquids until they evaporate. The addition of peat moss should overcome this problem and assist the process.

Finally, the venting system may be affected by hot weather. When the surrounding air is as warm as the air in the pipe, the column in the vent pipe will not rise. Hence the odour of the uncomposted contents of the tank may seep throughout the house. A small exhaust fan should solve this problem. Also painting the stack black to absorb the heat of the sun and thus warm the air inside the pipe has been found to improve the venting of systems installed where no electrical power is available.



Large Composting Toilet.

Care should be taken not to add substances that are non-biodegradable, such as tin cans or plastic containers. These systems are **NOT** garbage disposal units. The waste is added primarily to improve the composting process.

Large Scale Composting

A large unit takes time to reach its steady state condition in which the tank continuously accepts wastes, and emits a continuous supply of compost under ideal conditions.

Filling the tank takes longer than one might expect, since the composting process reduces the original volume by about 90%.

The Smaller Composter

The small composting toilets essentially consist of a box with a comfortable seat on top. The size of the box varies but it will fit into most bathrooms. No hole in the floor is needed, but a two-inch to four-inch vent-pipe must be led outside.

Hence the smaller composting mass can no longer be left to find its own operating temperature. The contents must be heated by a small, low-temperature electric resistance

unit fitted below the composting wastes. In addition, a small fan in the vent pipe is also essential, both to draw air through the contents, and prevent odours from emerging when the lid over the seat is raised.

In due course, the matured compost must be removed from the toilet. This task should not be necessary more often than every six months to a year. In most units, the composting sewage rest on a screen about the bottom of the box. The owner, using a mechanical device supplied with the unit, disturbs the bottom layers so that the material drops through the screen into a collecting bin, which can be removed and emptied.

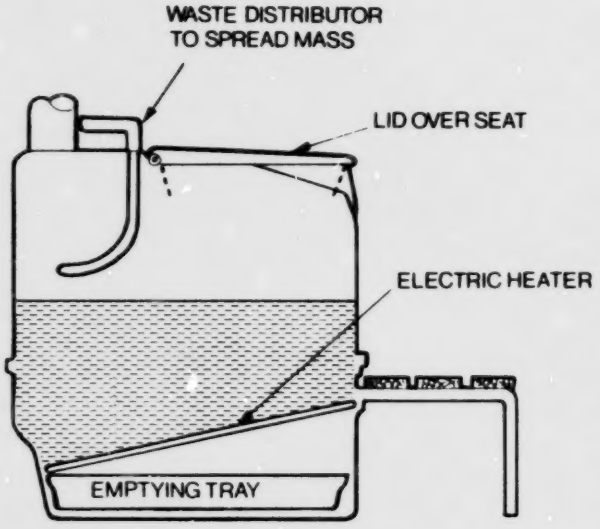
Because of their size, small units are designed to accept only toilet wastes. Here many of them encounter the same problem as their larger counterparts; the wet and close-packed wastes resist all efforts to draw air through them and set up their own unsavoury anaerobic system. If the urine can drain away or evaporate quickly, the solid residue can set into a firm block.

Several units come with an internal device for stirring (and thus aerating) the mass, usually operated by a handle projecting outside the unit.

The manufacturers of some units recommend adding cellulose to keep the mass loose enough to be aerated. The addition of vegetable scraps in moderate amounts also helps accomplish this.

Composting May Stop In Winter

Like most micro-organisms, those that cause aerobic decomposition work best when they are comfortably warm. They slow down as they cool, and become dormant at low temperatures. A composting tank kept outdoors or in an unheated basement cannot be expected to operate well in winter. The chilled bacteria wait for spring, and the tank serves primarily as a holding tank. Your system should be sized accordingly. For this reason where a composting toilet is installed in a cottage for year-round use, it should be elevated off the floor 5 - 8 cm if there is no basement. This allows warm air from the room to circulate around it and keep the contents warm.



Small Composting Toilet.

The warmth and nutrients in composting toilets make it ideal for raising fly larvae. The mild down-draft at the toilet and garbage chute may or may not be enough to contain the swelling population. A well-designed vent pipe comes complete with a fine-mesh fly-screen, which will probably prevent these insects from entering the tank by this route, but there are other routes.

Because the well-being of composting bacteria is so important, you cannot use disinfectants. Fortunately, biodegradable insecticides are available from the manufacturers of some composting toilets.

Is Compost Safe?

As every gardener knows, compost supplies excellent natural enrichment when dug well into the soil. Manure and human wastes have long been used for the same purpose, and in some places still are.

Since bacteria and viruses responsible for many serious human diseases pass out of the body with the feces, some precautions are necessary.

In a compost heap the bacteria, etc., will die from the lower temperatures, the drier conditions, and the competition of the natural (and harmless) bacteria of the soil. Compost, which has spent enough time in a composting toilet, will usually contain only the micro-organisms commonly found in garden soil.

But if the residence time is short, or if the toilet is experiencing problems, matters may be different.

The makers of composting toilets generally recommend using the unit's product freely to nourish shrubs and flowers. However, the well composted product should be dug in rather than spread as fertilizer on the ground. They recommend it for vegetables too. We discourage its use in this manner on vegetables that you eat. Use some other fertilizer around the roots of root vegetables, or in soil in which salad vegetables grow.

Alternative Approaches
Low-Volume Toilets
(Minimum-Flush)

These toilets closely resemble the standard flush toilet, except for the reduction in water use. Where the standard toilet typically requires 15 - 20 litres per flush, the low-volume toilet uses an economical two litres.

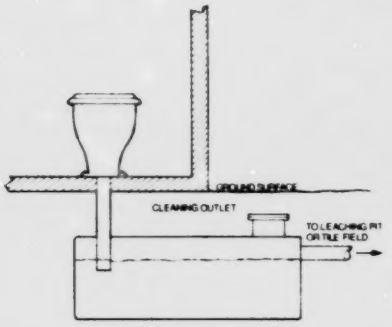
To avoid odor, some models are designed with a water seal in the form of a spring-loaded plate which presses upward against a gasket. A foot-pedal tilts the plate down after use, permitting wastes and flush-water to flow to the septic tank. After the pedal is released the spring-loaded plate closes and a portion of the clean flush-water is retained in the bowl.

As an additional advantage, in areas lacking pumped water, some units can be flushed manually by pouring a quart or so of water into the bowl. The disadvantages tend to centre around the seal. Toilet paper can prevent the plate from seating properly, so the water seal is lost, and with it odor protection.

Repeated use can distort the plate or gasket slightly, with the same result. And don't let your foot slip off the pedal controlling that spring-loaded plate. The plate has been known to snap back into place with such vigor that the contents are spilt.

Low volume flushing toilets do not of course reduce the solid content of the sewage. For this reason, the septic tank requirements are the same as a normal flush toilet system.

Any reduction in the amount of distribution pipe used in the leaching bed will be at the discretion of local authorities. A reduction cannot be expected if the amount of water saved is indefinite, due to: the manner in which the toilet operates; its reliability; or if use of the water saving device is discontinued.



Minimum Flush Toilet

Water Saving Devices

Some cottagers are installing water saving devices (in the tank of conventional toilets) to conserve water.

While this is unlikely to affect the size of the tile bed required, using less water will extend the bed's life — and reduce the chances of nutrients searching your lake.

Incidentally, putting a brick in your toilet tank to save water is a questionable solution. The brick displaces water and reduces the water available for a flush, i.e. you will not get such on efficient flush.

Second, over the years the brick will deteriorate. It's quite likely that brick particles will then prevent the tank's outlet flapper from closing. Which means you will lose water continuously.

Holding Tank

There are instances where, because of inadequate soil on the lot or the limited size of the lot, a satisfactory subsurface sewage disposal system is not possible to service an existing cottage or home.

In these circumstances, the only solution may be to install a holding tank.

A holding tank is exactly what the name implies. It is a tank that will hold the sewage until it can be pumped out and disposed of in an acceptable manner — usually at a sewage treatment plant.

A holding tank by regulation must be of at least 4500 litre capacity and equipped with either a visible or audio alarm system (preferably both). This alarm system should be set to trigger while there is still a sufficient capacity left in the tank until the pump-out truck arrives.

SUMMARY

Class 1 System

Includes various types of unsewered toilets. Its use with new construction is uncommon due to the sewage disposal requirements for nonhuman waste, (see class 2 system below) unless water conservation is important. With a Class 4 or 6 system installed to handle a pressurized water system, there is no other advantage to a Class 1 system.

Class 2 System

A soak or leaching pit. Only used for non-human waste and only suitable where water borne waste volumes are low. Not normally authorized with new construction as a sewage system capable of treating all waste from modern plumbing and appliances is preferred. May be authorized at the Director's discretion for use in conjunction with a Class 1 sewage system.

Class 3 System

A cesspool. Similar in construction to a Class 2 leaching pit, but only used to receive waste from a Class 1 system, i.e. human waste. Requires approval to install.

Class 4 System

A septic tank system.

Class 5 System

A holding tank, only used where other disposal solutions are impractical, or in temporary situations. Rarely approved with new construction.

Class 6 System

Packaged aerobic treatment plant system.

CHAPTER VI
FISH CONTAMINATION

Which Sport Fish to Eat?

Fish in many parts of the world have been affected by industrial or natural contaminants. In Ontario, the metal mercury has been the principal trace contaminant affecting fish. The government's continuous testing program has also detected traces of such man-made compounds as DDT, mirex and polychlorinated biphenyls (PCBs) in some fish from some water bodies. We're all concerned about this because prolonged consumption of contaminated fish could lead to severe illness.

These contaminants, however, have never been detected in water in sufficient quantities to make any Ontario lakes or rivers unfit for swimming or as a source of treated drinking water.

Thousands of Ontario's lakes and rivers have fish that are free from significant contamination. Others contain fish that are contaminated to some degree, and may be consumed occasionally. Fish from some lakes contain enough contaminants to make them unsuitable for consumption. Usually these are the larger, more mature fish that have accumulated the contaminant over many years.

The Contaminants of Concern

The contaminants detected in Ontario sport fish that can cause health problems are mercury, PCB, mirex and DDT. Other substances, such as lead, arsenic and cadmium, are also being monitored. But concentrations found to date indicate that these do not pose a hazard.

Fish containing mercury, PCB, mirex or DDT show no outward effects, and only modern laboratory techniques can determine levels of contamination.

The Ministry of Environment's symbol for its Fish Contaminant Monitoring Program.

1. Mercury

Mercury is a naturally occurring metallic element familiar to people through its widespread use in thermometers. It is found in low concentrations in most rocks and soils, and is particularly abundant in some areas of the Precambrian Shield.

Natural deposits are thought to result in elevated levels of mercury in fish in areas far removed from man-made sources. Airborne mercury from both natural and man-made sources may further be contributing to mercury in fish in some areas.

Mercury has also been widely used in industrial and commercial applications, such as the production of chlorine and caustic soda in chlor-alkali plants, and the manufacture of scientific and technical equipment.

Mercury compounds have also been used to: prevent the growth of fungi in pulp and paper mills; treat seed grains; and prevent snow mould on golf courses.

Action by government and industry during the late 1960s and early 1970s have virtually eliminated mercury discharges from major industrial sources.

Effects on Fish

Mercury — whether naturally occurring or from an industrial source — attaches to small sediment particles and settles to the lake or river bed. In these bottom sediments micro-organisms convert almost any mercury compound to the organic or methylmercury form.

It is thus readily available for rapid absorption by a fish, either directly from the water passing over its gills, or ingested with the organisms that form its diet. Since fish eliminate mercury at a very slow rate, concentrations gradually accumulate.

The longer a fish has been exposed to mercury in the environment, and the more mercury contaminated food it has consumed, the higher its mercury level. Thus, large or old fish that consume primarily smaller fish will contain much more mercury than smaller and younger fish, or fish that have a varied diet.

Effects on Humans

Humans eliminate methylmercury at a much faster rate than fish. Therefore, if fish are consumed only during a fishing trip of a few days or weeks (or if fishermen limit their long-term intake of mercury-contaminated fish to occasional meals) dangerous levels will not accumulate in the body.

Mercury, however, is present in

small concentrations throughout the environment. Consequently, everyone has small amounts of mercury in their body. Most individuals have a level of up to two or three milligrams total body burden, a level not known to cause any problems.

Based on methylmercury poisoning epidemics in Japan and Iraq, signs or symptoms of mercury poisoning are not found in individuals with body burdens of less than 20 milligrams of mercury (or about seven to ten times the body burden of average Canadians).

The central nervous system is most affected by methylmercury.

Some signs of poisoning include: lack of co-ordination; the feeling of "pins and needles"; numbness of the lips and mouth; constricted visual field; night blindness; tremor; deafness and diminished taste and smell. At the extreme, mercury poisoning may result in death.

It should be pointed out that many symptoms listed above are common to other ailments not associated with mercury. Extensive medical testing is required to confirm mercury poisoning.

The consumption guidelines developed for use by Ontario's anglers are based on federal guidelines supplemented by recommendations prepared by the World Health Organization.

Consumers following the guidelines can be assured that mercury levels in their bodies will remain far below levels where poisoning symptoms begin to appear.

The guidelines were developed for adults and, since the mercury level within the body is directly related to body weight, extra caution must be taken to protect a child or a fetus. It is therefore recommended that children under 15 and women of childbearing age should consume only fish with a mercury content of less than 0.5 parts per million, the federal guideline for commercially marketed fish.

2. **Polychlorinated Biphenyls (PCBs)**

PCBs are a group of chlorinated organic compounds developed in the 1920s. These chemicals are not formed in the natural environment so their presence in fish can always be attributed to man's activities.

PCBs are very stable; they do not easily break down chemically or naturally, and burn only at extremely high temperatures.

These properties led to widespread use of PCBs in transformer fluids, hydraulic fluids, oils, greases, fire retardants, and plasticizers in such products as paints, inks and adhesives.

Recently, two harmful effects of PCBs on animals have been detected in scientific tests. The compounds interfere with fertility, pregnancy, birth and development of offspring. Secondly, PCBs may be carcinogenic. Until the environmental and health hazards of PCBs were discovered, no special precautions were taken to prevent losses to the environment. Today, the use and disposal of PCBs or PCB-contaminated equipment is very closely regulated. Recently, the production of PCBs was stopped by the only North American manufacturer.

The high affinity of PCBs for fats is a significant factor affecting concentrations in fish. Species with a high fat content, such as salmon, will tend to accumulate more PCBs than lean fish such as a walleye. Even within one species, individual fish with a higher fat content will generally contain more PCBs.

The federal guideline for the commercial sale of fish containing PCB is an upper limit of 2.0 parts per million. The angler's guidelines based on the advice of medical specialists, suggest that fish with a PCB level above 2.0 ppm should be eaten only by adults occasionally (except women of childbearing age and children under 15) as outlined in the consumption guidelines.
(See Chapter 13.)

3. **Mirex (Dechlorane)**

Mirex is a chlorinated carbon compound used as a pesticide in the southern United States, but never registered for such use in Canada. Because of its chemical stability, mirex (also known as "Dechlorane") was used by two southern Ontario companies in the 1960s as a fire retardant in their manufactured products.

The behaviour of mirex in the aquatic environment is similar to that of PCBs in that it does not break down easily by natural processes. It too has a high affinity for fats, and following ingestion accumulates in the fatty tissues of fish.

Animal experiments have found that mirex is a possible cause of cancer.

In Ontario, mirex has been detected primarily in fish from Lake Ontario. The source was found to be a former processor of mirex in Niagara Falls, New York. Mirex in water or fish from sources adjacent to the two former Ontario users has not been detected.

The provisional guideline for the commercial sale of fish containing mirex is 0.1 parts per million. The angler's guidelines suggest that fish with mirex above 0.1 ppm should be eaten only by adults occasionally (except women of childbearing age and children under 15) as outlined in the consumption guidelines.
(See Chapter 13.)

4. DDT

DDT was developed during the Second World War to control a wide variety of insects. Afterwards it gained widespread use as an insecticide for agricultural and public health use.

DDT is also not easily broken down in the natural environment. The accumulation of DDT in fish caused markedly reduced reproductive capability in a number of species and led to restrictions in its use in the mid- 1960s. In 1969, Ontario's Pesticides Control Act limited its use to very specific purposes by special permit only.

DDT also accumulates in the fatty tissue of fish. The federal guideline for the commercial sale of fish containing DDT is 5.0 parts per million. The angler's guidelines recommend that fish with DDT levels above 5.0 ppm should be eaten only by adults occasionally (except women of childbearing age) as outlined in the consumption guidelines. (See Chapter 13)

DIOXIN:

Dioxins are a group of 75 chemicals of the chlorodibenzodioxin family. One compound – 2, 3, 7, 8, -TCDD (tetrachlorodibenzodioxin) is extremely toxic. At low doses 2, 3, 7, 8 - TCDD has been shown to be carcinogenic and to affect reproduction in laboratory animals; it is therefore considered to have the potential to cause similar effects in humans.

Dioxins are not useful manufactured chemical compounds; 2, 3, 7, 8 -TCDD, for example, is a trace by-product of the manufacture of 2, 4, 5-trichlorophenol and may therefore be found in very small amounts in that chemical, its manufacturing wastes and in chemicals manufactured from 2, 4, 5-trichlorophenol, such as the herbicide 2, 4, 5-T.

No dioxin was detected in 75 water samples from the Great Lakes basin, and the majority of the fish were also free of the contaminant. Minute traces of dioxin have been found only in a few fish collected from Lake Ontario, and in all cases the levels were less than the federal guidelines for regular consumption at the rate of one meal of fish per week.

Ontario's Fish Contaminant Monitoring Program

Since the mid-1960s, when DDT was first measured in fish, Ontario has completed an extensive monitoring program. During 1969 and the early 1970s, intensive sampling for mercury in fish was undertaken in the English-Wabigoon system of northwestern Ontario and the St. Clair River-Lake St. Clair system (of the Great Lakes) in southwestern Ontario. Both these basins were affected by mercury discharges from industrial sources. Since that time the program has expanded to investigate the impact of other industries, mining sites, areas of natural mineral deposits, commercial fishing areas, and lakes used as a source of food supply by Ontario's native peoples. In more recent years, the program has been broadened to include surveys of popular angling waters.

The Fish Contaminant Monitoring Program is a co-ordinated undertaking of the Ontario Ministries of Natural Resources, Environment and Labour.

Biologist from Ministry of Natural Resources lake survey team removes a lake trout from the fishing net.

Fish are collected primarily by staff of the Ministry of Natural Resources and analyzed at the Ontario Ministry of the Environment laboratories. Medical implications of contaminants are evaluated by medical specialists with the Ontario Ministry of Labour.

Federal agencies and other laboratory facilities have also carried out fish contaminant testing. The Ministries of Natural Resources and Environment will include these data in the guidelines whenever possible.

How Lakes are Selected for Testing

There are more than 250,000 lakes and uncounted rivers and streams in Ontario. With the staff and facilities currently available, the Province can sample and analyze about 15,000 fish per year. With the analysis of all appropriate species and representative size ranges of each species from each lake, 200 to 250 lakes or rivers can be sampled every year.

Obviously, every lake and river cannot be tested. To make the best use of resources, sampling site selection is a most critical challenge. The selection program is carried out principally by the Ministries of Natural Resources and Environment. Test

areas are selected for one or more of the following reasons:

- a popular angling area
- a commercial fishery
- a major source of food for local inhabitants (usually lakes in the vicinity of Indian Reserves)
- a known or suspected source of pollution nearby
- lakes opened for recreational development

Some areas are also sampled for scientific studies of the long-term behavior of contaminants in fish populations. For example, the analysis of annual fish samples from Lake St. Clair over the past eight years has revealed a steady decline in mercury levels since major industrial sources were stopped.

What Fish Species are Selected?

Within most lakes and rivers there are obviously many different species of fish. Given the limitations of manpower and analytical resources it would be impractical and, in fact, unnecessary to sample all species.

Mercury, for example, is a classic food chain pollutant. Such fish as walleye, pike, lake trout and bass eat other fish as a major part of their diet. As a result, they contain higher mercury levels than such non-predatory fish as whitefish, sunfish and catfish.

Therefore, when testing the fish from any given watercourse, predators are usually selected on the assumption that if their mercury content is low, then non-predatory species will also have low mercury levels.

When testing for PCB, mirex or DDT, a different selection process is followed. The organic pollutants have a high affinity for fats. Therefore, fish with a high fat content such as salmon, smelt and perch are collected.

Most fish are collected using netting techniques. In some cases fish are selected from commercial fishermen's catch. Whenever possible the collection includes 15 to 30 fish of each species, representative of the size range from the lake being tested.

For each fish collected, the length, weight and sex are recorded. In some cases, scale samples are kept so that the age of the fish can be determined.

A boneless, skinless fillet of dorsal muscle is removed from the fish, preserved and packaged for shipment to the Ministry of Environment laboratory for chemical analysis.

The information about the individual fish, along with the laboratory analysis results, are used in developing the lake-by-lake, species-by-species, size specific contaminant classification tables.

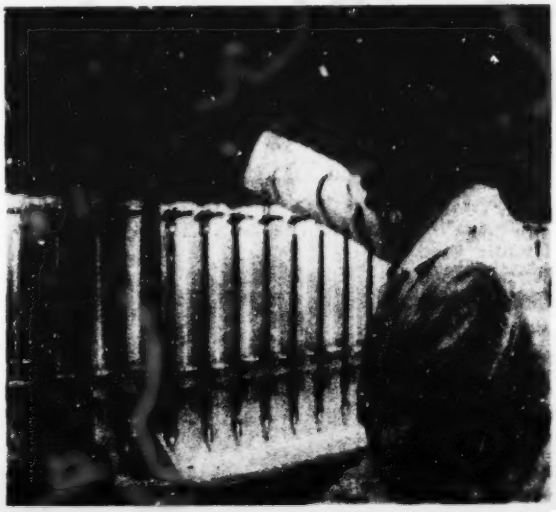
What About Your Lake?

The lake selection process is influenced in some cases by the interest shown by anglers.

If there are lakes you would like to see tested, please write to the appropriate regional or district offices of either the Ministries of Natural Resources or Environment. A listing of these offices appears in Chapter 12.

More Information

For more details on fish contaminant levels in Ontario lakes, see "Guide to Eating Ontario Sport Fish", available from Environment Ontario. Refer to Chapter 13.



After landing, fish are filleted and tagged.

Environment Ontario technician separates interfering substances from fish muscle extract before analysis for PCB contamination.

CHAPTER VII

CONTROL OF BITING INSECTS (Mosquitoes, Black Flies)

. . .Without Using Pesticides!

Those insects! They bite you (and your pets), and just make your life miserable.

What can you do?

Why not try insect control — without using pesticides?

Pesticides are not always the answer, for a number of reasons.

First, pesticide spraying or fogging near cottages produces extremely temporary benefits, and usually doesn't justify the hazard involved in possibly contaminating nearby water.

Secondly, eradication of biting fly populations is very rarely possible under any circumstances. Significant control is rarely achieved without large-scale programs involving substantial funds and trained personnel.

Limited use of approved larvicides in small areas of swamp or in rain pools close to private property can be carried out by individual cottagers. But **permits** are necessary wherever treated waters may contaminate adjacent streams or lakes.

Because of these drawbacks, two other ways of reducing insect attack are preferred.

1. mosquito populations can be reduced by improving land drainage, and eliminating the pools where they breed; and
2. insects can be dissuaded from biting by the use of repellents.

House Mosquito.

Life cycle of the Black Fly.

Ways to Eliminate Breeding Sites

The following suggestions will help you to reduce the numbers of these insects:

- Eliminate all standing water around the cottage if possible;
- Change water in wading pools or bird baths every week;
- Keep water from pooling on the surface of pool covers or other similar plastic coverings;
- Swimming pools if properly filtered and chlorinated will not be suitable for mosquito larvae;
- Dispose of empty cans or pails, up-end buckets or any other container left outdoors;
- Clean out clogged eavestroughs; drain flat roofs;
- Empty old tires and dispose of them;
- Do not clog drainage ditches with trash; make sure that ditches and driveway gutters drain properly;
- Empty water from stored boats;
- Cover rain barrels;
- Fill in sunken land to prevent standing water; and
- Reduce vegetation through mowing weeds and grass, trimming hedges and removing unnecessary shrubbery and trees that protect the adult mosquito against sun and wind.

How To Avoid Bites

- If working or visiting in areas where mosquitoes are abundant, wear loose protective clothing, i.e. long-sleeved shirt, light jacket, slacks and socks;
- Where black flies are abundant, be sure shirt cuffs and pant legs are tightly secured to stop insects from crawling inside.
- **Note:** Lighter colored clothing is less attractive to mosquitoes than dark clothing; dull material is more attractive to black flies than shiny material.
- Restrict outdoor activity in the evening when mosquitoes are most active; and in daytime in wooded areas;
- Repair the holes in windows or door screens; ensure the screens are tight;
- Close the damper on your fire place when not in use.
- Use netting over carriage when babies are left outside.

Repellents

Repellents are available in both liquid or stick form. Read the instructions carefully before using, and do not get the material in your eyes or mouth. The types that contain a higher concentration (in percentage) of the active ingredient will do a better job. Apply frequently, particularly on hot days.

Foggers

Temporary relief (immediately outside the cottage, in small areas such as yards or patios), may be achieved by using insecticides with mist-type sprayers or foggers when mosquitoes are flying (usually one hour before to one hour after sunset).

On exposed surfaces where mosquitoes are likely to rest, residual sprays may be applied, usually with a compressed air garden-type sprayer. Look for products labelled for mosquito and black fly control. Use only as directed.

For use indoors, insecticides are available in various forms — aerosols in pressurized cans, strips of embedded plastic and coils. All are effective for mosquito control if used according to the instructions. (Black flies are rarely a problem indoors because they spend their energy trying to get outside.)

Blackflies can be particularly bothersome in the early weeks of summer. They breed in fast-flowing watercourses so the most effective way of fighting them is by using a larvicide over a large area. However, this kind of project is best managed by a community or provincial government agency.

For further information, consult "Controlling Mosquitoes and Black Flies in Ontario", published jointly by the Ministries of Natural Resources and Environment. Copies are available from the Pesticides Control Section, Ministry of the Environment, 135 St. Clair Ave. W., Toronto, Ontario M4V 1P5.

Controlling Other Pests

What are the other insects that may need control? The following section discusses the most common ones — with tips on keeping their numbers down.

Eastern Tent Caterpillar.

Forest Tent Caterpillar.

a. **Eastern Tent Caterpillar**

Although this native insect prefers to feed on apple and cherry, it also attacks a wide variety of deciduous trees and shrubs.

The larvae are caterpillars about 50 mm (2 inches) long, and are clearly marked with a white stripe down their entire back and tufts of long, light brown hair.

This caterpillar doesn't usually cause too much economic damage. The trees they attack are of little commercial value and only rarely are trees killed.

Control without pesticides can be achieved by:

1. Pruning and destroying egg masses during the winter when they are easily collected; and
2. Pulling the tent from the branch with a gloved hand, or cutting the branch off and burning it.

When the caterpillars begin to appear in mid-May, insecticides can be used. For detailed information, write: Pesticide Control Section, Ministry of Environment, 135 St. Clair Avenue West, Toronto M4V 1P5 or contact your Regional Ministry offices.

b. **Forest Tent Caterpillar**

This is a widely distributed insect that feeds on poplar, sugar maple, oak, ash and birch trees. Its life cycle is the same as that of the eastern tent caterpillar.

Although this species is referred to as a tent caterpillar, it does not make tents. Instead, it makes a silken mat on a branch of the tree where many caterpillars congregate to rest or moult.

Full-grown caterpillars are quite attractive with long tufts of hair, a blue stripe running the length of each side and a row of diamond-shaped white spots along the middle. After six weeks of feeding, the caterpillar finds a sheltered place in which to spin a cocoon and then pupate. Eggs are laid in rings around twigs.

Control without pesticides is achieved by removing branches with

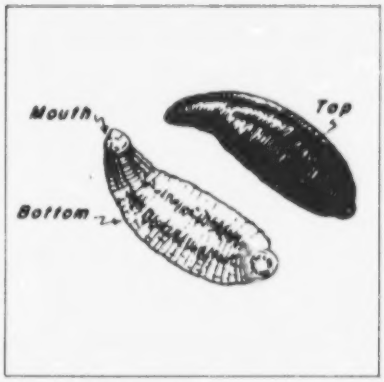
eggs, and burning branches where caterpillars congregate.

c. **Leeches (Bloodsuckers)**

A common nuisance to swimmers, leeches (better known as "bloodsuckers") are flattened worm-like animals. They normally feed on worms, snails, insect larvae and other small aquatic animals, but, if given the opportunity, will also feed on human blood.

They are typically found in shallow, protected waters, concealed among aquatic plants or under stones, logs and other debris. Being strong swimmers they are attracted to water disturbance around docks and swimming areas. On hot summer days they are most active, but in winter they're buried in mud just below the frost line.

The best control for leeches is to keep your beach clean by removing all vegetation and debris that harbor the large number of aquatic animals upon which they feed. Control of aquatic vegetation with herbicides



The common leech.

(see Chapter II), and the removal of stones, logs and other debris from warm, shallow water should keep the immediate swimming area relatively free from this nuisance.

Several alternative methods are available that may help reduce a leech population. Freezing leeches in their winter homes may be possible if the infested area is a pond.

When the first thin ice starts to form and the water temperature has attained its minimum, the water should be drawn off as rapidly as possible until the level has been lowered at **least 1.5 metres.**

This low level must be maintained for at least five to six weeks during the coldest part of the winter. The exposed flats will freeze to a considerable depth, a circumstance that is fatal to the imprisoned leeches. This is, however, a drastic measure that affects other life in the pond and should not be considered lightly.

A second measure, which has proved successful, is bait trapping. A metal can with a reclosable lid (a one pound tobacco or coffee can is ideal) drilled with small holes (depending on the size of the nuisance species) and baited with raw meat may trap very large numbers of leeches from a heavily infested area.

After feeding, the leeches will have difficulty leaving the can. Destruction of the can and its contents will obviously help considerably in reducing the size of the leech population.

CHAPTER VIII
PESTICIDES

Pesticide Safety

Supposing you've tried insect control without pesticides, but the nuisances are still around. So you've decided to consider using pesticides.

The pointers that follow will help you use these chemical compounds, and ensure that they have no adverse effects on you or the environment.

To use pesticides to the best advantage, become well informed about their safe and correct handling and use. Observe the following precautions:

Careful Purchasing

Always carefully choose the pesticide. Check the label for the insect you wish to treat. To ensure the product is effective the insect you wish controlled should be listed on that label.

If the product you choose is a spray, note whether it is a **surface** or **space** spray. **Surface** sprays are applied to floor base-boards, shelving, etc., and leave a residual quantity of active pesticide to attack crawling insects. In contrast, **space** sprays are more dilute, short-lived pesticides

that are sprayed into the air to kill flying insects.

Pesticides are sold at garden centres, hardware stores and exterminators' outlets. If you have a small problem to overcome, purchase only a small quantity of pesticide. This avoids later storage or disposal problems.

Safe Storage

As soon as you arrive at the cottage with the pesticide, (whether it is mothballs, resin strips, weedkiller or insecticide) find a secure place to store it — **if possible in a locked compartment**.

Choose a place out of the reach of children or pets. Be sure it is away from food, medicine, housekeeping supplies or garden supplies (seeds, fertilizers) to avoid any possibility of accidental contamination. Also, check the label for any special precautions. If the pesticide is flammable, do not place near heat.

Keep the pesticide tightly closed in its original labelled container. If the label falls off, glue it back onto the container. If an unlabelled container is discovered, discard it. Don't guess at the contents.

Safe Application

Always read the label on the pesticide container every time the pesticide is used. It is easy to forget an important caution or application method.

Never allow children to assist with a pesticide application. Be sure all pets and their feeding dishes are removed from the treatment area — this includes cats and dogs, birds and their cages, and aquaria.

If treating cupboards (or table areas), remove nearby food, dishes or utensils first. After treatment, cover the shelving with foil or new shelf paper before replacing these goods. (And thoroughly wash the table areas.)

When applying the pesticide, be careful. If you spill pesticide on your skin, wash it off immediately with soap and water. If you accidentally spill some liquid pesticide, mop it up with absorbent material — such as sawdust or garden soil — which can be discarded safely by putting it in a garbage bag. While doing this, your hands should be protected by rubber gloves.

Work efficiently so as to limit inhalation of the pesticide spray or dust. Never smoke while working with pesticide since it may be carried to your mouth on the cigarette. In any case, many pesticides are flammable.

If you must dilute the pesticide or mix it with a solvent, do not work in the kitchen sink or use eating utensils that could be accidentally placed back in service. Make up only enough pesticide for the present use. Mix outdoors or in a well ventilated area.

Use insecticides outside only on calm days for safety and minimal annoyance to neighbors.

When you have completed the application of the pesticide, clean up. Wash your hands and face with soap and water. Remove clothing and launder separately from other family clothing before wearing again. If a residual pesticide has been applied, leave the cottage for several hours to allow the pesticide solvent to disperse. Occasionally, this solvent may be irritating.

Disposal of Empty Containers

An empty pesticide container — cardboard box, tin or bottle — should never be used again. Dispose of it safely by wrapping it in newspaper or a plastic bag, and placing it in the garbage can. Never burn empty pesticide containers — the smoke or fumes produced may be toxic. Plastic containers should never be punctured.

AND IN AN EMERGENCY

For first aid treatment, read the label on the pesticide container.

If possible, immediately call your doctor or nearest Poison Control Centre. Read details of the label to the doctor — name of product, active chemical ingredient, antidote — and ask the doctor what to do. If you go to hospital, take the label with you.

Write the phone number of your nearest Poison Control Centre Here:

CHAPTER IX

SOLID WASTES

Try Composting Cottage Wastes

Many cottage areas are simply not equipped to dispose of vast quantities of garbage.

So anything you can do to reduce the garbage volume will help.

When you shop, avoid heavily packaged items. Buy returnable bottles. And return them!

At the end of your stay at the cottage, consider taking your garbage back to the city (especially in winter when garbage pick-up may not be so frequent). Also, consider composting.

Many cottagers are becoming avid compost gardeners. In this way you can recover tangible benefit from your garbage, and thus reduce the volume of solid waste requiring disposal.

The humus material from a compost heap has long been accepted as an inexpensive soil additive and mulching agent. When added to the top soil, it improves texture, porosity and water holding capacity, and increases the organic content of the soil.

How To Compost

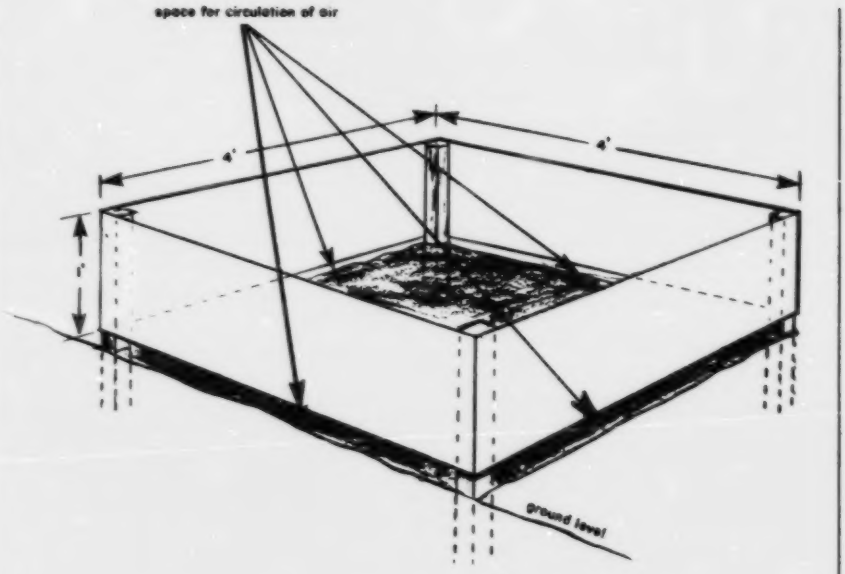
Generally speaking, composting involves taking organic waste material and placing it in a soil culture rich in natural organisms.

The following steps provide a simple, inexpensive approach to constructing a compost heap:

Locate Away From Water

You can locate your compost heap in an inconspicuous corner of your cottage property, or you can choose a central site and decorate it to suit the landscape.

Be sure, however, that the spot is airy and sunny. Also be sure that it is away from waterways and wells, and at least one foot above the water table.



Construction

Composting is best done in some form of enclosure. Choose a size convenient to your needs, whether it's a three foot square box or an enclosure ten feet on a side. The pile can be as shallow as one foot or as deep as five feet.

Simple Enclosure

For small-scale, easy composting the simplest approach is to take a large garbage can, a barrel or a wooden box. Knock out the bottom and set it up to receive your organic wastes.

Custom Enclosure

A composting enclosure can also be tailor-made in any size. These directions show how to build an enclosure four feet square rising one foot above ground level.

- Mark off a 4-foot square on the ground and dig a pit between 12 inches and 18 inches deep. The pit provides some warmth in winter and keeps the compost damp in summer.

(1 ft = 30.50 cm;
1 in = 2.54 cm)

- Drive four stakes approximately 2 inches square by 2 ft. long into the ground at the corners leaving 1 foot of the stake above ground.
- From a sheet (8' x 4') of quarter-inch aspenite plywood, cut four 1' x 4' rectangles and nail them to the stakes forming a 4' x 4' enclosure. Leave a small space, about one inch, around the bottom so that air can circulate up through the heap. The remaining half of the sheet will be used as a cover for your heap during winter. In summer, a sheet of heavy gauge plastic placed on 4' x 4' frame of 2 inch stock will be used as a cover. This keeps your compost heap from becoming a breeding ground for insects — and will also help retain moisture.

Your composting bin is now ready to receive organic wastes.

Composting Methods

Many methods for adding waste material to compost heaps are used. The simplest is to add material as it becomes available. Be sure not to add thick layers of finely ground

Home composting is easy to do and can involve the whole family.

material such as sawdust. These materials will pack tight and prevent adequate circulation of air.

Another method is to arrange your compost heap into layers by placing a thin layer of a commercial starter (or fertilizer) between each 6 - 8 inches of garbage. The starter is used to increase the bacteria count, and the fertilizer will increase the nutrient content of your pile.

Whichever method you choose, remember that for your compost to function adequately, the heap must be kept moist but not soggy. Every two or three weeks the pile should be turned to mix and aerate the raw compost.

While the garbage is decomposing, heat is produced which should be contained by covering the pile. Heat is essential to keep the compost functioning effectively and decompose the waste.

After every turning of the heap, heat again builds up in a matter of hours. When the heat production finally stops, your compost is ready to be used as low grade fertilizer and soil conditioner.

When is Your Compost Ready?

Experts suggest that your compost should be ready after one full year. Although if you complete filling in the fall, you may be able to set it aside for use in the spring. Much will depend on the composition of your heap and how often the pile is turned.

And in Winter?

If you use your cottage all year, maintain two compost heaps. One can be kept in use during winter while the other matures.

What To Compost

Organic wastes are the main source of material for a composting heap. These are typical everyday household ingredients including:

- Kitchen garbage
- vegetable and fruit peelings
- coffee grounds
- *egg shells
- peanut and nut shells
- leaves
- grass clippings
- *sawdust
- pet waste
- *torn-up newspaper
- barbecue grill residue
- straw and hay
- garden residues

*acceptable in small quantities.

With a little time and effort, and minimal expense, you can successfully reclaim some of your cottage wastes.

What Not To Compost

All glass, china, tin cans.

About Open Burning

Open fires cause air pollution. Their smoke and odours can aggravate respiratory conditions, soil property, reduce visibility and generally lessen enjoyment of property. In rural areas, the effects are less noticeable, however, if at all possible, do not open burn leaves, grass, stumps, fallen trees, trash, crop stubble and other materials.

There are alternatives. Depending upon the nature of the materials involved, they can be buried, composted, set out for Municipal collection or taken directly to a local dump or sanitary landfill site.

If you must burn, follow these guidelines to keep your fire from becoming an air pollution problem — not to mention a forest fire problem.

(Remember all air pollution complaints received by the Ontario Ministry of the Environment are investigated and corrective action can be taken under The Environmental Protection Act, 1971.)

- Burn only dry materials. Don't burn petroleum products, plastics, rubber or anything else that will cause excessive smoke or fumes.

(Continued Overleaf)

About Open Burning *(continued)*

- Keep your fire at least 150 metres from a dwelling.
- Burn less than a cubic yard of material at a time.
- Stay with your fire at all times.
- Don't burn where smoke will bother your neighbors or blow across roadways and hamper driving visibility. Smoke from open burning has caused several serious traffic accidents in Ontario.
- Check local bylaws enforced by your fire or police department. If burning above Ontario's Fire Line, follow regulations enforced by the Ministry of Natural Resources.

  (The Fire Line runs east from Lake Huron across the bottom of Georgian Bay and the top of Lake Simcoe down to Gananoque, then north and west to meet the Ottawa River north of Renfrew).

For further information on open burning, contact the nearest regional or district office of Environmental Ontario.

CHAPTER X
BOATING

A Look at the Environmental Issues.

The use of high-speed power boats has become one of the most maligned activities in cottage country.

Is this really justified? Just how much of a problem are they?

The key environmental issues are discussed below: sewage contamination; gasoline and oil contamination; noise, and wash.

What To Do With Sewage

To help protect lakes and rivers from pollution, it's required by Ontario law that sewage (and garbage) from all pleasure craft — including houseboats — be retained in suitable equipment. (i.e. You don't just dump wastes overboard. You retain them for disposal at an approved pump-out facility).

If you equip your boat with toilet facilities, the equipment shall be:

1. non-portable;
2. constructed of structurally-sound material;
3. of adequate capacity for its expected use;
4. properly installed; and
5. equipped with the necessary pipes and fittings conveniently located for pump-out by shore-based facilities. (Although not specified, a pump-out deck fitting with 1½-inch diameter National Pipe Thread is commonly used.)

It is your responsibility to ensure that your vessel is properly equipped.

Environmental Tips for the Boat Operator

1. Wastes should be retained and disposed of on shore.
2. Always keep engine tuned; an un-tuned one wastes fuel, so adjust (and keep clean) the plugs, ignition points, fuel systems and carburetors.
3. Use correct gas and oil mixture. Use lead-free or low lead gas if your motor will run on it.
4. Avoid spillage.
   (a) Fill portable tank away from the water;
   (b) Don't overfill fuel tanks. Leave space for expansion if the fuel warms up;
   (c) Fill your gasoline tank carefully to avoid blow-back.
5. Don't run the motor if not necessary. If waiting at a dock for someone, turn your engine off.
6. Reduce speed near shore or in narrow channels. (Under federal legislation, the Ministry of Natural Resources has the authority to restrict the operation and speed of pleasure boats.);
7. When buying an engine, insist on a quiet one;
8. When a tank is used for outboard motor testing, the contents should not be emptied into the water.
9. If the bilge is cleaned, the waste material should not be dumped into the water;
10. Empty oil cans should be deposited in a leak-proof receptacle.

Inspection, part of the Ministry of the Environment's regulation enforcement program.

SLOW DOWN AND SAVE FUEL

Oil and Gas Contamination Fuel Spills-The Major Problem

Exhaust gases and oil discharges from boats can pose minor problems, but more damaging are fuel spills caused by careless handling.

Their effects on water are both short and long term. Gasoline has an immediate effect on the microbiota (small life in water), while oil has adverse effects on the phytoplankton and zooplankton. Although the oil does not kill these organisms, it does hinder their reproduction.

Since phytoplankton and zooplankton are a source of food for other aquatic life, their absence would upset the ecological balance in lakes and rivers.

Studies have also shown that oil in water has adverse effects on both the lifetime and growth of fish.

Fuel spills can be prevented. So you can do something.

What about oil discharges?

Fortunately, newer outboard motors are designed to prevent the discharge of crankcase drainage. As the use of these motors increases, less unburned fuel will be emitted into the water.

Normally lead should not be a serious problem. Most marine fuels sold in Ontario are low in this metal and can efficiently operate most outboards.

Of note is the possible effect of exhaust products on water, altering its odour and tainting fish flesh in high traffic lakes.

Marina & Yacht Club Requirements

An Ontario regulation requires that marinas and yacht clubs must provide or arrange pump-out service for customers and members who have toilet equipped boats.

In addition, litter containers must be conveniently available.

Visitors Must Comply Too!

Visiting pleasure boats, including foreign owned vessels maintained in Ontario must comply with Ontario regulations.

Visiting pleasure craft, equipped according to out-of-province regulations requiring non-portable sewage holding or incinerator systems, must comply with the Ontario regulations.

CHAPTER XI

DEVELOPMENT

How to Protect a Finite Resource?

The tremendous pressure for development exerted on our cottage country is one of the many symptoms of our society's rapid growth on a finite resource base. Unless we stabilize our population, resource consumption and economic growth at reasonable levels, our cottage country will continue to be gobbled up by "progress".

We in Ontario are realizing that lakes, like all ecosystems, have limits. For some large, deep southern Ontario lakes with ample soil, the capacity is high. However, for more fragile Precambrian lakes with little soil cover over bedrock, the capacity is quite low.

If a lake's development capacity is exceeded (i.e. overdeveloped), the combined effects of pollutants and other pressures will cause a degraded environment from both an ecological and aesthetic point of view.

It may take several years for the effect of overdevelopment to become obvious, but there's no escaping its inevitable results.

And it will be made worse by the trend towards winter cottaging.

Controlling Development

When cottagers see increasing development around their lake as a threat to their seclusion, their natural view and other aspects of the environment, they begin to oppose further development. This opposition increases when developers fail to take into account what cottagers regard as the environmental and social limits of the lake.

But who decides these limits and how can they be maintained?

A large part of this question depends on the water quality of the

lake. Cottagers and cottage associations can help Environment Ontario tackle the water quality problems in their lake by providing information through Self-Help Programs.

Valuable protection can be provided to wildlife, to fish and the scenic value of the lake. Many of these recommendations are not enforceable by law, but must rely on alert and concerned cottagers to practice conservation, and pass the message to their neighbors.

To enable the provincial government to better understand and define the environmental and social limits of a lake, an extensive provincial Lakeshore Capacity Study is now under way to provide additional guidance.

Some cottage associations have taken their concern for increasing development on a lake to their local municipality. A Lake Plan would require detailed study of the lake's characteristics, including how much development has occurred to date. The Plan, once adopted by the local municipality or planning board, would establish guidelines for any future development. By following the precautionary measures described in the Lake Plan, any new cottage development allowed should have minimal impact on the lake and its residents.

Keeping the View Natural

The view of forested hills, peaceful farm lands or undisturbed shoreline from a cottage or boat is a valuable part of the cottaging experience. The view can be preserved, despite extensive cottage development, by using adequate building setbacks from the lake and by preserving natural vegetation near the shore.

This requires the co-operation of cottage association members who realize that the view from the cottage is enhanced by looking through and at natural vegetation.

Keeping the Wildlife

Part of the attraction of lakeshore living is the opportunity to encounter wildlife in its natural state. But wildlife often moves away from areas developed by people, even lakeshores. However, cottagers can do something to encourage wildlife to stay.

Certain areas such as marshes and swamps, forests which provide cover and food for deer, and other wildlife habitat, are protected by the Ministry of Natural Resources. The public can contribute to this habitat protection program by being concerned about unique species, and by preserving areas used by furbearing animals, waterfowl, fish and other wildlife.

A cottage association should contact the Ministry of Natural Resources if members have a concern to preserve a unique species or area. The association can also help retain wildlife in its area by discouraging such activities as chasing wildfowl with power boats, disturbing nesting areas, and allowing dogs to run at large.

Shoreline alterations, and the filling of wetlands, can harm wildlife. The Ministry of Natural Resources will provide advice before work is done around a cottage that might disturb wildlife activities.

In some areas cottagers have a problem with wildlife. For instance, beavers can build dams which flood recreation areas or roads. The Ministry of Natural Resources can assist cottagers in dealing with these problems. In the case of beavers, the Ministry can enlist a licenced trapper to control beaver populations.

Keeping the Fish

Sport fishing is an important and relaxing pastime for many cottagers. The quality of good sport fishing in a lake can be impaired by a number of factors including: over-fishing; changes in water quality; and disturbances of spawning beds and nursery areas.

A minimum number of adult fish must be retained in a body of water to spawn and maintain an abundance of fish for future seasons. This is why the Ministry of Natural Resources limits fishing pressures by reducing catch limits or shortening seasons.

It has already been explained how cottagers can reduce the flow into the lake of nutrients that fertilize algae and weeds. Controlling nutrient flows also helps protect fish because the weeds and algae use oxygen when they decompose, robbing fish of oxygen.

Cottage associations can help retain fish populations too by not disturbing the important spawning and nursery areas in the shallow parts of the lake. It is the shallow areas where much of the food and habitat for fish is provided, and these are very sensitive to man's activities.

The effect of a large number of cottagers, each of whom makes a small "improvement" in his cottage shoreline, is cumulative and disrupts the natural aquatic life processes.

Reducing contaminant flow into the water with the shoreline vegetation and adequate setbacks for buildings does a great deal to maintain the productivity of the shallow areas. The following additional measures will also help:

Constructing Piers and Docks — Consider floating rather than permanent structures to avoid damaging the lake bottom.

Beaches — If there are rocks in front of your property, leave them. If you must remove rocks for better swimming, move them by hand, not with a bulldozer.

Boathouses — Keep the boathouse back from the shore, and use a winch to bring the boat out of the water.

Boat Ramps — Use a community ramp rather than many individual ones.

Power Boats — Known fish spawning areas should be avoided by power boats. The disturbance of the lake bottom can cause eggs to be covered with sediments that prevent fish from hatching.

Before building any structures on a lakeshore, contact the Ministry of Natural Resources.

One Municipality's Action Plan

On the municipal level there is great variation in environmental awareness and action. One of the most progressive, the Township of Muskoka Lakes, has:

- passed its own by-laws on sewage disposal systems;
- conducted an information campaign;
- hired students to perform a sanitary survey on the most critical areas;
- followed-up the survey with correction through its by-law enforcement officers;
- promoted a boycott on detergents by hiring students to visit each cottage and trade a box of soap for the cottager's box of detergent; and
- passed by-laws to restrict development.

ENQUIRE WHAT YOUR MUNICIPAL GOVERNMENT IS DOING!

CHAPTER XII
FOR FURTHER INFORMATION

Ministry of the Environment

Regional & District Offices

NORTHWESTERN REGION:

Thunder Bay Regional Office,
435 James St. S.
Thunder Bay P7C 5G8
Tel: 807/475-1315

Kenora District Office,
808 Robertson St.,
Kenora P9N 1X9
Tel.: 807/468-5578

NORTHEASTERN REGION

Sudbury Regional Office,
199 Larch St.
Sudbury, P3E 5P9
Tel.: 705/675-4501

Timmins District Office,
83 Algonquin Blvd. W.,
Timmins P4N 2R4
Tel.: 705/264-9474

Sault Ste. Marie District Office,
445 Albert St. E.,
Sault Ste. Marie P6A 2J9
Tel.: 705/949-4640

North Bay District Office,
1500 Fisher St., Northgate Plaza,
North Bay P1B 2H3
Tel.: 705/476-1001

Parry Sound District Office,
74 Church St.
Parry Sound P2A 1Z1
Tel.: 705/746-2139

CENTRAL REGION

Suite 700, 150 Ferrand Dr.,
Don Mills M3C 3C3
Tel.: 416/424-3000

Barrie District Office,
12 Fairview Rd.,
Barrie L4N 4P3
Tel.: 705/726-1730

Muskoka-Haliburton District Office,
Gravenhurst P0C 1G0
Tel.: 705/687-3408

Peterborough District,
139 George St. N.,
Peterborough K9J 3G6
Tel.: 705/743-2972

Halton-Peel District Office,
1226 White Oak Blvd.
Oakville L6H 2B9
Tel.: 416/844-5747

SOUTHWESTERN REGION

London Regional Office,
985 Adelaide St. South,
London N6E 1V3
Tel.: 519/681-3600

Windsor District Office,
250 Windsor Ave., 6th Floor,
Windsor N9A 6V9
Tel.: 519/254-5129

Sarnia District Office,
242 A Indian Rd. South,
Suite 209 S.,
Sarnia N7T 3W4
Tel.: 519/336-4030

Owen Sound District Office,
1180 20th Street
Owen Sound, N4K 1T9
Tel.: 519/371-2901

Chatham Sub-District Office,
435 Grand Ave. W.,
Chatham N7L 3Z4
Tel.: 519/352-5107

WEST CENTRAL REGION

Hamilton Regional Office,
Ontario Government Building
119 King St. W., 12th Floor
Box 2112
Hamilton L8N 3Z9
Tel: 416/521-7640

Cambridge District Office,
400 Clyde Rd.,
Cambridge N1R 5T8
Tel: 519/623-2080

Welland District Office,
637-641 Niagara St. N.,
Welland L3C 1L9
Tel.: 416/735-0431

SOUTHEASTERN REGION

Kingston Regional Office,
133 Dalton St.,
Kingston K7L 4X6
Tel.: 613/549-4000

Ottawa District Office,
2378 Holly Lane,
Ottawa K1V 7P1
Tel.: 613/521-3450

Cornwall District Office,
4 Montreal Road, 2nd Floor,
Cornwall K6H 1B1
Tel.: 613/933-7402

Belleville District Office,
15 Victoria Ave.,
Belleville K8N 1Z5
Tel.: 613/962-9208

Pembroke District Office,
1000 MacKay St.,
Pembroke K8A 6X1
Tel.: 613/732-3643

Ministry of Natural Resources

Regional and District Offices

NORTHWESTERN REGION

808 Robertson St.
Box 5160
Kenora Ontario
Tel.: 807/468-3111

District Offices

Red Lake District
Box 5003, Hwy. 105
Red Lake, Ontario
P0V 2M0
Tel: 807/727-2531

Kenora District
Box 5080
Kenora, Ontario P9N 3X9
Tel: 807/468-9841

Dryden District
479 Government Rd.,
Box 730
Dryden, Ontario P8N 2Z3
Tel: 807/223-3341

Sioux Lookout District
Box 309, Prince Street
Sioux Lookout, Ontario
P0V 2T0
Tel: 807/737-1140

Fort Frances District
922 Scott Street
Fort Frances, Ontario P9A 1J4
Tel: 807/274-5337

Ignace District
Box 448
Ignace, Ontario P0T 1T0
Tel: 807/934-2233

NORTH CENTRAL REGION

Ontario Govt. Bldg.
435 James St. S.
Box 5000
Thunder Bay 'F', Ontario
P7C 5G6
Tel: 807/475-1261

District Offices

Atikokan District
108 Saturn Ave.
Atikokan, Ontario P0T 1C0
Tel: 807/597-6971

Thunder Bay District
435 James St. S.
Box 5000
Thunder Bay 'F', Ontario
P7C 5G6
Tel: 807/475-1511

Terrace Bay District
Box 280
Terrace Bay, Ontario P0T 2W0
Tel: 807/825-3205

White River District
200 Winnipeg St.
White River, Ontario P0M 3G0
Tel: 807/822-2250

Nipigon District
Box 970
Nipigon, Ontario P0T 2J0
Tel: 807/887-2120

Geraldton District
208 Beamish Ave.
Box 640
Geraldton, Ontario P0T 1M0
Tel: 807/854-1030

NORTHERN REGION

140 Fourth Ave.
Box 3000
Cochrane, Ontario P0L 1C0
Tel: 705/272-4287

District Offices

Hearst District
631 Front St.
Box 670
Hearst, Ontario P0L 1N0
Tel: 705/362-4346

Kapuskasing District
6-8-10 Government Rd.
Kapuskasing, Ontario P5N 2W4
Tel: 705/335-6191

Moosonee District
Box 190
Moosonee, Ontario P0L 1Y0
Tel: 705/336-2987

Chapleau District
190 Cherry St.,
Box 460
Chapleau, Ontario P0M 1K0
Tel: 705/864-1710

Cochrane District
2 Third Avenue
Box 730
Cochrane, Ontario P0L 1C0
Tel: 705/272-4365

Kirkland Lake District
Box 129
Swastika, Ontario P0K 1T0
Tel: 705/642-3222

Timmins District
896 Riverside Drive
Timmins, Ontario P4N 3W2
Tel: 705/264-1262

Gogama District
Box 129
Gogama, Ontario P0M 1W0
Tel: 705/894-2000

NORTHEASTERN REGION

199 Larch St.
Sudbury, P3E 5P9
Tel.: 705/675-4120

District Offices

Sault Ste. Marie District
Aerodrome Bldg.
P.O. Box 130
875 Queen St. E.,
Sault Ste. Marie, Ontario
P6A 5L5
Tel: 705/949-1231

Wawa District
22 Mission Rd.
Box 1160
Wawa, Ontario P0S 1K0
Tel: 705/856-2396

Blind River District
62 Queen St.
Box 190
Blind River, Ontario P0R 1B0
Tel: 705/356-2234

Espanola District
Box 1340, 148 Fleming St.,
Espanola, Ontario P0P 1C0
Tel: 705/869-1330

Sudbury, District
Box 3500, Station "A"
Sudbury, Ontario P3A 4S2
Tel: 705/522-7823

Temagami District
Box 38, Lakeshore Drive
Temagami, Ontario P0H 2H0
Tel: 705/569-3622

North Bay District
222 McIntyre St. W.
Box 3070
North Bay, Ontario P1B 8K7
Tel: 705/474-5550

ALGONQUIN REGION

Brendale Square
Box 9000
Huntsville, Ontario P0A 1K0
Tel: 705/789-9611

District Offices

Algonquin Park District
Box 219
Whitney, Ontario K0J 2M0
Tel: 705/637-2780

Parry Sound District
4 Miller Street
Parry Sound, Ontario P2A 1S8
Tel: 705/746-2141

Bracebridge District
Box 1138
Bracebridge, Ontario P0B 1C0
Tel: 705/645-8747

Minden District
Minden, Ontario K0M 2K0
Tel: 705/286-1521

Bancroft District
Box 500
Bancroft, Ontario K0L 1C0
Tel: 613/332-3940

Pembroke District
Riverside Drive
Box 220
Pembroke, Ontario K8A 6X4
Tel: 613/732-3661

EASTERN REGION

Provincial Govt. Bldg.
Concession Rd.
Kemptville, Ontario K0G 1J0
Tel.: 613/258-3413

District Offices

Carlton Place District
10 Findlay Ave.,
Carlton Place, Ontario K7C 3Z6
Tel: 613/257-5735

Cornwall District
Box 1749
113 Amelia St.
Cornwall, Ontario K6H 5V7
Tel: 613/933-1774

Napanee District
Napanee, Ontario K0K 2R0
Tel: 613/354-2173

Brockville District
101 Water St. W.
Brockville, Ontario K6V 5Y8
Tel: 613/342-8524

Tweed District
Metcalf Street
Tweed, Ontario K0K 3J0
Tel: 613/478-2330

Lanark District
Box 239
Lanark, Ontario K0G 1K0
Tel: 613/259-2108

CENTRAL REGION

10670 Yonge St.
Richmond Hill, Ontario
L4C 3C9
Tel: 416/884-9203

District Offices

Lindsay District
322 Kent St. West
Lindsay, Ontario K9V 2Z9
Tel: 705/324-6121

Maple District
Maple, Ontario L0J 1E0
Tel: 416/832-2261

Huronia District
Midhurst, Ontario L0L 1X0
Tel: 705/728-2900

Cambridge District
RR 1
Beaverdale Rd.
Cambridge, Ontario N3C 2V3
Tel: 519/658-9356

Niagara District
Box 1070
Fonthill, Ontario L0S 1E0
Tel: 416/892-2656

Aylmer District
353 Talbot Street West
Aylmer West, Ontario N5H 2S8
Tel: 519/773-9241

Owen Sound District
611 Ninth Avenue East
Owen Sound, Ontario N4K 3E4
Tel: 519/376-3860

SOUTHWESTERN REGION

1106 Dearness Dr.
London, Ontario N6E 1N9
Tel: 519/681-5350

District Offices

Simcoe District
645 Norfolk St. N.
Simcoe, Ontario N3Y 3R2
Tel: 519/426-7650

Chatham District
435 Grand Ave. W
Box 1168
Chatham, Ontario N7M 5L8
Tel: 519/354-7340

Wingham District
Box 490
Wingham, Ontario N0G 2W0
Tel: 519/357-3131

Ministry of Northern Affairs

Community Services Offices

NORTHEASTERN REGION

Blind River
13 Lawton St., P0R 1B0
Tel: 705/356-2226

Chapleau
3 Birch St., P0M 1K0
Tel: 705/864-1515

Cochrane
161 Sixth Ave., P0L 1C0
Tel: 705/272-4274

Elliot Lake
10 Brunswick Walk, P5A 2A8
Tel: 705/848-7133

Espanola
100 Tudhope St., P0P 1C0
Tel: 705/869-1532

Hearst
Northern Seasons Motel
915 George St., P0L 1N0
Tel: 705/362-4358

Iroquois Falls
253 Ambridge Drive, P0K 1E0
Tel: 705/232-4001

Kapuskasing
Model City Mall, P5N 2E7
Tel: 705/335-6008

Kirkland Lake
32A Prospect Ave., P2N 3K1
Tel: 705/567-3291

Mindemoya
King and Young Streets, P0P 1S0
Tel: 705/377-5396

Moosonee
P.O. Box 307
Main Street, P0L 1Y0
Tel.: 705/377-5396

New Liskeard
310 Whitewood Ave., P0J 1P0
Tel: 705/647-7391

North Bay
267 Main St. West, P1B 2T8
Tel: 705/472-3911

Sault Ste. Marie
444 Queen St. East, P6A 1Z7
Tel: 705/254-6623

Sturgeon Falls
191 Main St., P0H 2G0
Tel: 705/753-2900

Sudbury
199 Larch St.
Sudbury, P3E 5P9
Tel.: 705/675-4451

Timmins
60 Wilson Ave., P4N 2S7
Tel: 705/267-1401

Wawa
55 Broadway Ave., P0S 1K0
Tel: 705/856-2354

NORTHWESTERN REGION

Atikokan
123 Marks St., P0T 1C0
Tel: 807/597-2701

Dryden
18 King St., P8N 1B1
Tel: 807/223-5231

Fort Frances
529 Mowat Ave., P9A 1Z1
Tel: 807/274-5329

Geraldton
103 Main St., P0T 1M0
Tel: 807/854-0266

Ignace
200 Beaver St., P0T 1T0
Tel: 807/934-2260

Kenora
12 Main St. South, P9N 3X9
Tel: 807/468-5548

Marathon
Peninsula Bldg., P0T 2E0
Tel: 807/229-1153

Rainy River
408 Atwood Ave., P0W 1L0
Tel: 807/852-3287

Red Lake
242 Howey St., P0V 2M0
Tel: 807/727-2870

Sioux Lookout
Prov. Bldg., 2nd Flr, P0V 2T0
Tel: 807/737-1318

Thunder Bay
428 E Victoria Ave., P7C 1A5
Tel: 807/475-1425

Ministry of Health Offices

Algoma Health Unit
Six Floor Civic Centre
99 Foster Drive
Sault Ste. Marie Ontario
P6A 5X6
Tel: 705/949-9111
Ext. 377

Brant County District Health Unit
194 Terrace Hill Street
Brantford, Ontario N3R 1G7
Tel.: 519/753-7377

Bruce County Health Unit
County Building
Rm 102
Box 248, 215 Cayley Street
Walkerton, Ontario N0G 2V0
Tel.: 519/881-1920

Borough of East York Health Unit
550 Mortimer Avenue
Toronto, Ontario M4J 2H2
Tel: 416/461-8136

Durham Regional Health Unit
Community Health Services Centre
301 Golf Street
Oshawa, Ontario L1G 4B2
Tel: 416/723-8521

Eastern Ontario Health Unit
340 Pitt Street, 2nd Floor
Justice Building,
Cornwall, Ontario K6J 3P9
Tel: 613/933-1375

Elgin-St. Thomas Health Unit
2 Wood Street
St. Thomas, Ontario N5R 4K9
Tel: 519/631-9900

Etobicoke Health Department
Etobicoke Civic Centre
Etobicoke, Ontario M9C 2Y2
Tel: 416/626-4532

County of Grey-Owen Sound Health Unit
County Building,
595 9th Avenue East
Owen Sound, Ontario N4K 3E3
Tel: 519/376-9420

Haldimand-Norfolk Regional Health Unit
365 West St.
Woolworth Building,
2nd Floor,
Box 247,
Simcoe, Ontario N3Y 4L1
Tel.: 519/426-6170

Haliburton, Kawartha, Pine Ridge District Health Unit
Box 337
Cobourg, Ontario K9A 4K8
Tel: 416/372-3375

Halton Regional Health Unit
1151 Bronte Rd.,
P.O. Box 7000
Oakville, L6J 6E1
Tel.: 416/827-2151

Hamilton-Wentworth Regional Health Unit
74 Hughson Street South
P.O. Box 897
Hamilton, Ontario L8N 3P6
Tel: 416/528-1441

Hastings and Prince Edward Counties Health Unit
208 Bridge Street East
Belleville, Ontario K8N 1N8
Tel: 613/966-5500

Huron County Health Unit
Court House
Goderich, Ontario N7A 1M2
Tel: 519/524-8301

Kent-Chatham Health Unit
435 Grand Avenue West
P.O. Box 1230
Chatham, Ontario N7M 5L8
Tel: 519/352-7270

Kingston, Frontenac & Lennox and Addington Health Unit
221 Portsmouth Avenue
Kingston, Ontario K7M 1V5
Tel: 613/549-1232

Lambton Health Unit
333 George Street
Sarnia, Ontario N7T 4P5
Tel.: 519/344-5293

Leeds, Grenville and Lanark District Health Unit
70 Charles Street
Brockville, Ontario K6V 1T3
Tel: 613/345-5685

Middlesex-London District Health Unit
346 South Street
London, Ontario N6B 1B9
Tel: 519/673-0110

Muskoka-Parry Sound Health Unit
Pine Street
Box 1019
Bracebridge, Ontario P0B 1C0
Tel: 705/645-4471

Niagara Regional Area Health Unit
King Street at Fourth
Welland, Ontario L3B 3L1
Tel: 417/735-5697

North Bay and District Health Unit
P.O. Box 185
200 McIntyre St. E
North Bay, Ontario P1G 8G8
Tel: 705/474-1400

Northern Ontario Public Health Service
6th Floor
15 Overlea Blvd.
Tel.: 416/963-1176

Northwestern Health Unit
15 Ocean Avenue West
R.R. No. 1
Kenora, Ontario P9N 3W7
Tel.: 807/468-3174

North York Health Department
5100 Yonge Street
Willowdale, Ontario M2N 5V7
Tel.: 416/224-6197

Ottawa-Carleton Regional Health Unit
1827 Woodward Drive
Ottawa, Ontario K2C 0R5
Tel: 613/225-2223

The Oxford County Board of Health
509 Brant Street
Box 485
Woodstock, Ontario N4S 7Y5
Tel: 519/539-6121

Peel Regional Health Unit
10 Peel Centre Dr.
Brampton, L6T 4B9
Tel.: 416/791-9400

Perth District Health Unit
653 West Gore St.
Stratford, N5A 1L4
Tel.: 519/271-7600

Peterborough County-City Health Unit
835 Weller Street
P.O. Box 246
Peterborough, Ontario K9J 4Y1
Tel: 705/743-1160

Porcupine Health Unit
234 Algonquin Boulevard East
Timmins, Ontario, P4N 1B2
Tel.: 705/267-1181

Renfrew County and District Health Unit
P.O. Box 940
1217 Pembroke Street East
Highway 17
Pembroke, Ontario K8A 7M5
Tel: 613/732-3629

Scarborough Health Department
Scarborough Civic Centre
160 Borough Drive
Scarborough, Ontario M1P 4N8
Tel.: 416/296-7454

Simcoe County District Health Unit
County Administration Centre
Midhurst, Ontario L0L 1X0
Tel: 705/726-9300

Sudbury and District Health Unit
1300 Paris Crescent
Sudbury, Ontario P3E 3A3
Tel: 705/522-9200

Thunder Bay District Health Unit
P.O. Box 1024
300 Lillie St. N.
Thunder Bay, Ontario P7C 4X8
Tel: 807/622-3961

Timiskaming Health Unit
6 Tweedsmuir Rd.
Kirkland Lake, Ontario P2N 1H9
Tel.: 705/567-9355

Toronto City Health Department
2nd Floor, City Hall
100 Queen St. W.
Toronto, Ontario M5H 2N2
Tel.: 416/367-7401

Waterloo Regional Health Unit
850 King Street West
Kitchener, Ontario N2G 1E8
Tel: 519/744-7357

Wellington-Dufferin-Guelph Health Unit
205 Queen Street East
Fergus, Ontario N1M 1T2
Tel: 519/843-2460

Metro Windsor-Essex County Health Unit
1550 Ouellette Avenue
Windsor, Ontario N8X 1K7
Tel: 519/258-2146

York Borough Health Department
2700 Eglinton Avenue West
Toronto, Ontario M6M 1V1
Tel: 416/653-2700

York Regional Health Unit
22 Prospect Street
Newmarket, Ontario L3Y 3S9
Tel: 416/895-4511

CHAPTER XIII
FURTHER READING

The Ontario Ministries of the Environment, Health and Natural Resources have developed publications that provide general information about environmental practices, regulations and programs. With exceptions, publications are free upon request. Priced publications are marked with an asterisk.*

Write: Publications Centre, Ministry of Government Services, 5th Floor, 880 Bay Street, Toronto, Ontario M7A 1N8.

Ministry of the Environment

General

Who Cares?

Legislation

The Environmental Protection Act, 1971 *

The Ontario Water Resources Act *

The Pesticides Act *

Water

Boating and Marina Regulations.
Water Management.
Goals, Policies and Implementation Procedures of the Ministry of the Environment.
Pump-Out Stations.
Drinking Water Objectives
Guide to Eating Ontario Sports Fish — Northern Ontario (Bilingual).
Guide to Eating Ontario Sports Fish — Southern Ontario (Bilingual).
Guide to Eating Ontario Sports Fish — Great Lakes (Bilingual).
Discharge of Sewage from Pleasure Boats.
Septic Tank Systems.
The case against the Rain (Acid Rain)
Water Wells and Ground Water Supplies in Ontario.

Air

Open Burning Guidelines.
Introduction to Air Pollution in Ontario.
How Air Pollution Affects Vegetation

Land and Waste Management

Be a Good Sort - A Guide to Residential Source Separation.

Simple Composting of Household Wastes.

Pesticides

Mosquito Control — What You Can Do.
Pesticides and the Environment.
Pesticides Safety in Your Home.

Should you require further information on pesticides use or safety, please contact the Pesticide Control Section, Ministry of the Environment, 135 St. Clair Avenue West, Suite 100, Toronto, Ontario M4V 1P5. (965-2401).

Educational

My Water Book — the story of water for grade school students.
From the Lakes. . .to the Trees — An environmental handbook for camp leaders.*

Introducing Your Child to Nature.*

A Citizen's Handbook on Water Pollution and its Control.

Ministry of Health

Allergies...and you.
Animals, Rabies and You.
Encephalitis
The Sun — Friend or Foe.
The Sting...what to do about insects that bite.
Happy Splashing. . .safety around the swimming pool.
Get in the swim.

Ministry of Natural Resources

Forests and Trees

The Forest Trees of Ontario. . .with Key to Identification. . .Details on 90 native trees and 45 imported species. 120pp, illus.*

Planning for Tree Planting.
Care and Planting of Forest Trees.
Forest Tree Grower's Calendar.

Common Pests of Ornamental Trees and Shrubs. . .Illustrated guide to identification and control of most common insects, mites and diseases.*

Wildlife

A Manual for the Identification of Hairs of Selected Ontario Mammals ...Photomicrographs and details on hairs of 54 species. 68pp.*

Deer Management in Ontario: The Future.

Ducks at a Distance, A Waterfowl Identification Guide...Lengths, weights, coloured pics and silhouettes of many species. 56pp.*

The Beaver in Ontario... Life history habits, habitat, numbers, management and importance. 20pp. illus.*

Fur Management in Ontario... Historical ups and downs and current progress; foldout of furbearers.*

Manual of Common Parasites, Diseases and Anomalies of Wildlife in Ontario...Descriptions of 23 subjects; 21 color plates; 120pp, 4"x7", water resistant paper.*

Moose Management in Ontario: Problems and Possible Solutions.

Ontario Turtles. . .Descriptions of eight species and their habits and habitats, plus hints on pet keeping. 24pp, illus.*

Vegetation Management for Wildlife in Ontario. . .Practical guide for resource managers and conservationists. 64pp, 44 drawings by Michael Dumas.*

The Ecology of the Timber Wolf in Algonquin Provincial Park. . .Report on seven-year study. 92pp, illus. Fold-in map.*

Wolves and Coyotes in Ontario... Life history, habits, relationships. 20pp, illus.*

Wildlife Management Areas in Ontario...Location and description of 40 areas.

Hunting. . .Map and summary of Ontario regulations.

Ontario Trapping Regulations (summary).

The Game and Fish Act and **the Endangered Species Act** (office consolidation).

Fish and Fisheries

Fish Ontario. . .Quick detail on presence or absence of 11 fish species in 4,582 Ontario waters located by township, county or district and degrees and minutes of latitude and longitude.*

Fish of Ontario...18"x24" wall poster of 20 species in full colour; descriptive notes.*

Ontario Angling — Facts and Figures...Detailed analyses of anglers' origins, fishing areas, catches by species, favored species, and funds expended. 100pp, color-keyed charts.*

Out of the Water...Report on Ontario's freshwater fishing industry and principal fishingwaters; detail on 28 fish species and families; 72pp, illus.*

Pacific Salmon's Role in Lake Ontario...Reprint from Fish and Wildlife Review, Vol. 18, No. 4, 1979. 9pp. illus.*

The Fisheries of Lake Simcoe. . . Report on an interesting lake. 140pp, illus.*

The Fisheries of Lake of the Woods . . .Comprehensive guide to lake and fishing. 44pp, illus. map.*

Trout and Salmon Migratory Routes, Northern Ontario Streams...38"x25" map folder.*

Trout and Salmon Migratory Routes, Southern Ontario Streams... 38"x25" map folder.*

Rainbow Trout in the Great Lakes. . . Distribution of rainbow trout in past 100 years. 76pp, illus.*

The Distribution and Characteristics of Ontario Lake Trout Lakes. . .32pp, 24" x 26" colour map shows 2,000 lake trout lakes.*

About Bait-Fish in Ontario. . .Descriptions and illustrations (21 colour plates) of major bait species, tested techniques of care and handling, and symptoms and treatments of common diseases. 60pp,.*

Trout and Salmon Migratory Routes, Northern Ontario Streams. . .38" x 25" map folder.*

Trout and Salmon Migratory Routes, Southern Ontario Streams. . .38" x 25" map folder.*

Ontario Angling — Facts and Figures . . .Detailed analyses of anglers' origins, fishing areas, catches by species favoured species, and efforts and funds expended. 100pp, colour-keyed charts.*

Fishing. . .Map and summary of Ontario regulations.

Ontario Fishery Regulations (office consolidation).

Fishing Maps (list of surveyed lakes).*

Outdoor Recreation

Conservation Areas in Ontario. . . Map with details on locations, features and facilities in 293 areas.

Canoe Routes of Ontario...A guide to more than 100 canoe routes. Includes a poster-size map.*

Hunter's Handbook, Part I...Complementary text to Hunter Safety Training course. 56pp, illus.*

Hunter's Handbook, Part II. . .Reference manual for hunters. 128pp, illus.*

Mining and Geology

Ontario Minerals... General guide for rockhounds; minerals shown in color.

Amethyst Deposits of Ontario . . .Guide to amethyst properties; lore and uses as gemstone. 108pp, illus.*

Collecting Ontario's Amethyst...A guide for rockhounds and families wishing to pick their own amethyst from Ontario's mines.

All that Glitters. . .Geology and mineral deposits.

Rocks and Minerals Information. . . Sources of geological and earth science maps and technical publications.

Ontario Mineral Map, No. 2310...*

Geology and Fossils, Craigleith... 61pp, illus.*

Geology and Scenery...Illustrated series*... Rainy River east to Lake Superior, GB1...128pp. North Shore of Lake Superior, GB2...156pp. Peterborough, Bancroft, Madoc Area, GB3...128pp.North Shore of Lake Huron, GB4...224pp.

Other Sources of Information

Environment Canada, Environmental Protection Service, Ottawa, Ontario K1A 1C8

The Ontario Federation of Anglers and Hunters, Box 28, Peterborough, Ontario G9J 6Y5.

The Federation of Ontario Cottages' Associations, 215 Morrish Suite 105, Scarborough, Ontario M1C 1E9

The Federation of Ontario Naturalists, 1262 Don Mills Road, Don Mills, Ontario M3B 2W7

Canadian Nature Federation, 46 Elgin Street, Ottawa, Ontario K1P 5K6

Canadian Wildlife Federation, 1673 Carling Avenue, Ottawa, Ontario K2A 1C4

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